UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

ESCORT INC.,

***Plaintiff*,**

v.

UNIDEN AMERICA CORPORATION,

***Defendant*.**

CIVIL ACTION NO.: 3:18-cv-00161-N

APPENDIX IN SUPPORT OF UNIDEN'S OPPOSED MOTION FOR LEAVE TO AMEND ITS PRELIMINARY INVALIDITY CONTENTIONS

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EXHIBIT 1

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ESCORT INC., **Plaintiff,** **v.** **UNIDEN AMERICA CORPORATION,** **Defendant.**	**CIVIL ACTION NO. 3:18-cv-00161-N**

DEFENDANT'S FIRST SUPPLEMENTAL PRELIMINARY INVALIDITY CONTENTIONS

Pursuant to ¶¶ 3-3 and 3-4 of Miscellaneous Order No. 62 ("Misc. Order 62"), Defendant Uniden America Corporation ("Defendant") hereby provides its First Supplemental Preliminary Invalidity Contentions, which include the accompanying claim charts, to Plaintiff Escort Inc. ("Escort").

As disclosed in its Misc. Order 62 ¶ 3-1 Disclosure of Asserted Claims and Preliminary Infringement Contentions served on Defendant, Escort asserts the following patents and claims:

Patents	Claim(s)
U.S. Patent No. RE39,038	7, 9, 11–14, 16, 19–21, 23–24, 27, 29–31, 33–36, 38, 41–42 and 49–50
U.S. Patent No. RE40,653	22, 25–34, 36–38, 41–47 and 49–50
U.S. Patent No. 7,576,679	1–3, 10–12, 28–33 and 40–43

The patents identified above are together herein referred to as "the Asserted Patents," and the claims identified above are together herein referred to as "the Asserted Claims" unless reference is made specifically with respect to particularly identified one or more of the Asserted Patents and/or one or more of the Asserted Claims.

Defendant hereby: (a) identifies each currently known item of prior art that either anticipates or renders any Asserted Claim obvious; (b) specifies whether each such item of prior art anticipates any Asserted Claim or whether an item of prior art, either alone or in combination with other items of prior art, renders any Asserted Claim obvious; (c) submits charts identifying where each element in the Asserted Claims is disclosed, described, or taught in the prior art; (d) identifies the grounds for invalidating the Asserted Claims based on indefiniteness under 35 U.S.C. § 112, ¶ 2, or enablement or written description under 35 U.S.C. § 112, ¶ 1; and (e) preliminarily identifies such additional grounds for invalidity of the Asserted Claims as are presently known.

As further detailed in and supported by these First Supplemental Preliminary Invalidity Contentions, Defendant contends that each of the Asserted Claims is invalid under at least 35 U.S.C. §§ 101, 102, 103, and/or 112. Defendant reserves the right to prove the invalidity of the Asserted Claims on bases other than those required to be disclosed in these disclosures pursuant to Misc. Order 62 ¶ 3-3.

In addition, pursuant to Misc. Order 62 ¶ 3-4(a) and (b) and based on its investigation to date, Defendant has produced or hereby produces documents currently in its possession, custody, or control required to accompany these First Supplemental Preliminary Invalidity Contentions. Defendant reserves the right to supplement this production during the course of discovery as any additional relevant materials are located.

Consistent with Misc. Order 62 ¶ 3-6, Defendant reserves the right to amend these First Supplemental Preliminary Invalidity Contentions. The information and documents that Defendant produces are provisional and subject to further revision. Defendant expressly reserves the right to amend the disclosures and document production herein should Escort provide any information that

it failed to provide in its Misc. Order 62 ¶ 3-1 and 3-2 disclosures, produce additional prior art, or amend its Misc. Order 62 ¶ 3-1 or 3-2 disclosures in any way.

Further, because discovery has not closed and because Defendant has not yet completed its search for and analysis of relevant prior art, Defendant reserves the right to revise, amend, and/or supplement the information provided herein, including identifying and relying on additional references, should Defendant's further search and analysis yield additional information or references, consistent with Miscellaneous Order No. 62 and the Federal Rules of Civil Procedure. Moreover, Defendant reserves the right to revise its ultimate contentions concerning the invalidity of the Asserted Claims, which may change depending upon the Court's construction of the Asserted Claims, any findings as to the priority date of the Asserted Claims, and/or positions that Escort or its expert witness(es) may take concerning claim construction, infringement, and/or invalidity issues.

Prior art not included in this disclosure, whether known or not known to Defendant, may become relevant. In particular, Defendant is currently unaware of the extent, if any, to which Escort will contend that limitations of the Asserted Claims are not disclosed in the prior art identified by Defendant. To the extent that such an issue arises, Defendant reserves the right to identify other well-known components or references that *inter alia* would have made the addition of the allegedly missing limitation to the disclosed device or method obvious. In other words, Defendant reserves the right to identify other references that would disclose the allegedly missing limitation(s) of the claimed method, device, or system.

Defendant's claim charts cite to particular teachings and disclosures of the prior art as applied to features of the Asserted Claims. The cited portions are only examples, and Defendant reserves the right to rely on uncited portions of the prior art references. In addition, if helpful,

Defendant may point to other publications as aids in understanding and interpreting the cited prior art references, by for example, providing context to show how one of ordinary skill in the art would interpret a portion of a prior art reference. Defendant further reserves the right to rely on any evidence or prior art included in its production, UNIDEN_0000401 – UNIDEN_0001591, whether or not it is charted.

In addition to the positions and prior art identified below and the accompanying invalidity claim charts, Defendant also incorporates by reference all invalidity contentions, prior art, and invalidity claim charts (including, without limitation, all anticipation positions, obviousness positions (including all prior art combinations and motivations to combine), indefiniteness positions, and enablement positions) disclosed at any time – regardless of whether in the past or future, regardless of whether in formal litigation – to Escort, Escort's attorneys or representatives, any one or more of the named inventors, individuals associated with prior owners and assignees of one or more of the Asserted Patents, individuals and entities associated with the prosecution of one or more of the Asserted Patents, and/or Escort's affiliates in connection with one or more of the Asserted Patents, including but not limited to disclosures or statements by entities that Escort has sued, entities that Escort has threatened to sue or otherwise sought out by Escort for licensing purposes, the U.S. Patent and Trademark Office, and foreign patent offices. These proceedings include but are not limited to the following litigations and patent office proceedings: *Fleming v. Escort Inc.*, Case No. 1:09-cv-105 (D. Idaho); *Fleming v. Escort Inc.*, Case No. 1:12-cv-66 (D. Idaho); *Fleming v. Cobra Elecs. Corp.*, Case No. 1:12-cv-392 (D. Idaho); *Fleming v. Escort Inc.*, Case No. 1:15-cv-542 (D. Idaho); and *Escort Inc. v. noLimits Enterprises, Inc.*, Case No. 1:18-cv-323 (S.D. Ohio). Defendant further incorporates by reference IPR2013-00203 and IPR2013-00240 which relate to subject matter disclosed in the '679 Patent. As stated above, those prior

invalidity contentions, claim charts, prior art, and related documents are incorporated herein by reference as if being set forth in at least the same level of detail herein as previously provided to Escort.

Further, Defendant incorporates, in full, all prior art references cited in the Asserted Patents and any patents to which the Asserted Patents claim priority, and the Asserted Patents' respective prosecution histories.

These First Supplemental Preliminary Invalidity Contentions are based on Defendant's current understanding of the Asserted Claims and Escort's apparent view of the scope of those claims as shown, for example, in its Infringement Contentions. A *Markman* Order in this case has not yet been issued, and in no way shall these First Supplemental Preliminary Invalidity Contentions be taken as any admission or acquiescence by Defendant as to the proper scope of the Asserted Claims and/or proper claim constructions of terms and phrases recited in those claims. By identifying prior art that anticipates and/or renders obvious the Asserted Claims, Defendant does not admit that the claim limitations are capable of construction and do not adopt Escort's apparent claim constructions or admit the accuracy of any particular claim construction.[1]

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[1] Defendant does not concede that Escort's constructions are correct, but rather assert the well-established principle that whatever infringes a claim if later in time anticipates if earlier in time. *Bristol-Myers Squibb Co. v. Ben Venue Labs., Inc.*, 246 F.3d 1368, 1378 (Fed. Cir. 2001). Thus, where Escort for purposes of its infringement case alleges that a feature of an accused product meets a particular limitation recited in one or more of the Asserted Claims, then that feature, should it be found in the prior art, would also cause that limitation to be met for invalidity purposes.

Indeed, Defendant contends that Escort is accusing Defendant of infringement based on the same functionality that was well known and disclosed in the prior art, as exemplified by the following prior art disclosure (Second Declaration of Steven K. Orr Under 37 C.F.R. § 1.131, dated August 19, 2005, ¶ 4):

> Prior to January 27, 1998, I created a family of tools for collecting field data from a radar detector, so that data could be stored from each radar encounter of the detector. The system involved a radar detector cabled (via fiber optics) to a laptop's

Defendant reserves all rights to later challenge or oppose any claim constructions advanced by Escort and to present claim its own claim construction positions.

Nothing stated herein shall be treated as an admission or suggestion that Defendant agrees with Escort regarding either the scope of any of the Asserted Claims or the apparent claim constructions advanced by it in its Infringement Contentions or anywhere else. Moreover, nothing in these First Supplemental Preliminary Invalidity Contentions shall be treated as an admission that Defendant's accused technology meets any limitations of the Asserted Claims.

Nothing stated herein shall be construed as an admission or a waiver of any particular construction of any claim term. Defendant also reserves all rights to challenge any of the claim terms herein under 35 U.S.C. § 112 including by arguing that they are indefinite, not supported by the written description and/or not enabled. Accordingly, nothing stated herein shall be construed as a waiver of any argument available under 35 U.S.C. § 112.

Defendant further reserves the right to revise these First Supplemental Preliminary Invalidity Contentions in view of the Court's construction of terms and phrases recited in one or more of the Asserted Claims, additional information obtained during discovery, additional infringement theories put forth by Escort during fact and/or expert discovery, any findings as to the priority date(s) of the Asserted Claims,[2] and/or positions that Escort, its fact witnesses, or its expert witness(es) may take concerning claim construction, infringement, and/or invalidity issues.

> COM port. When the detector encountered a radar signal sufficient for an alert, spectral information and the band of the encountered radar signal were recorded by the laptop computer, which also emitted an audible "beep."

[2] In an abundance of caution, Defendant has identified prior art based on Escort's alleged priority date for the '038 and '653 Patents as April 14, 1999. However, the '038 Patent matured from a reissue application filed on January 28, 2003, and the '653 Patent matured from a continuation of that application. Thus, to the extent the Asserted Claims of the '038 and '653 Patents are

Defendant further reserves the right to supplement its accompanying Misc. Order 62 ¶ 3-4(b) document production should it later discover additional prior art documents, information, testimony, prior art systems and related documentation, and/or software or hardware code, including information provided by third parties after the date of service of these First Supplemental Preliminary Invalidity Contentions.

Defendant may further rely on inventor admissions concerning the scope or state of the prior art relevant to the Asserted Claims, the patent prosecution histories of the Asserted Patents, related patents and/or patent applications, any deposition or trial testimony of the named inventor on the Asserted Patents, and the papers filed and any evidence produced or submitted by Escort in connection with these cases or other related litigation. Defendant reserves the right to contend that one or more of the Asserted Claims are invalid under 35 U.S.C. § 102(f) in the event that they obtain evidence that the named inventors did not invent the subject matter in the Asserted Claims.

The references identified in these First Supplemental Preliminary Invalidity Contentions, which include the attached claim charts, may disclose the elements of the Asserted Claims explicitly and/or inherently, and/or they may be relied upon to show the state of the art in the relevant time frame. References identified in these First Supplemental Preliminary Invalidity Contentions, as well as the "References Cited" on the face of the Asserted Patents and the patents cited within the body of the Asserted Patents, may be used to illustrate, but not limit the scope of, the state of the art to which the Asserted Patents pertain (i.e., at a time prior to the date of alleged inventions of the Asserted Claims of the Asserted Patents). Moreover, Defendant reserves the ability to rely on later identified sources of information, including but not limited to witness

determined to have been impermissibly broadened in the reissue applications, Defendant reserves the right to identify additional prior art based on a later priority date.

testimony and other discovery, to establish the state of the art in the relevant time frame pertaining to the Asserted Patents.

Because discovery has just recently begun, Defendant anticipates that additional prior art and invalidity bases may be found. Defendant's investigation and analysis of the prior art is continuing, and thus Defendant reserves the right to supplement, amend, and/or revise the information provided herein as Defendant conducts further investigation and/or analysis, including identifying, charting, and relying on additional references.

Additionally, in view of likely third-party discovery that will be taken, Defendant reserves the right to present additional items of prior art under 35 U.S.C. §§ 102(a), (b), (e), and/or (g) and/or § 103 located during discovery or further investigation, and to assert contentions of invalidity under 35 U.S.C. §§ 102(c), (d), or (f). For example, Defendant expects to issue subpoenas to third parties believed to have knowledge, documents, and/or other evidence concerning invalidity of one or more of the Asserted Claims.

I. MISC. ORDER ¶ 3-3(A)(1) – IDENTIFICATION OF PRIOR ART

A. Admissions

By way of example only, the Asserted Patents admit that various problems were well known in the prior art, as well as systems and methods for addressing those problems. Examples of these acknowledged problems, systems, and methods serve as secondary reference(s) for obviousness combinations or as motivation(s) to combine two or more references. The "Background of the Invention" sections (and any other portions describing the state of the art or prior art) of the Asserted Patents shall be taken as admissions by Escort of content known in the prior art. Such prior art content is hereby incorporated by reference.

B. Prior Art

Pursuant to Misc. Order 62 ¶ 3-3(a)(1), and subject to Defendant's reservation of rights, Defendant identifies in the table below each item of prior art that anticipates or renders obvious the Asserted Claims. Again, to be clear, Defendant's identification of prior art incorporates by reference and includes all prior art and invalidity grounds previously disclosed to Escort in other proceedings or instances, at any time.

Prior art under 35 U.S.C. §102(b) is identified by specifying the item offered for sale or publicly used or known, the date the offer or use took place or the information became known, and the identity of the person or entity which made the use or made and received the offer, or the person or entity which made the information known or to whom it was made known.

Prior art under 35 U.S.C. §102(f) is identified by providing the names of the person(s), if known, or other identifying information, if not known, from whom, and the circumstances under which the invention or any part of it was derived.

Defendant further intends to rely on inventor admissions concerning the scope of relevant prior art, the patent prosecution history for the Asserted Patents and related patents and/or patent applications, any deposition testimony of the named inventors listed on the Asserted Patents, and the papers filed and any evidence submitted by Escort or any of its predecessors-in-interest in conjunction with this litigation or other proceedings involving one or more of the Asserted Patents.

1. Prior Art Patents, Published Patent Applications, and Publications

Defendant identifies the following patents, published patent applications, and publications as prior art that anticipates and/or renders obvious one or more of the asserted claims under pre-AIA 35 U.S.C. §§ 102(a), (b), (e), or (g), or § 103. Certain prior art patents, patent applications, and/or publications identified below describe or are otherwise associated with corresponding prior art systems or methods. Defendant may rely on these patents, applications, and publications to

provide evidence or corroboration of prior use, sale, offers for sale, knowledge, and/or invention under the provisions of pre-AIA 35 U.S.C. § 102. In addition, Defendant may also rely on each prior art patent, application, and publication as an independent basis for invalidity separate and distinct from reliance upon any corresponding prior art system, method, or other related publications, patents, and patent applications.

Country	Patent No. or Title / System Name	Primary Inventor / Author	Date of Issue[3] / Publication / Date of Sale, Offer, or Public Availability	Filing Date
US	4,581,769	Grimsley	4/8/1986	1/31/1984
US	4,622,553	Baba	11/11/1986	9/20/1984
US	4,631,542	Grimsley	12/23/1986	9/28/1984
US	4,698,632	Baba	10/6/1987	6/19/1985
US	4,709,407	Baba	11/24/1987	10/1/1985
US	4,750,215	Biggs	6/7/1988	6/24/1986
US	4,791,420	Baba	12/13/1988	12/29/1987
US	4,817,000	Eberhardt	3/28/1989	3/10/1986
US	4,831,498	Baba	5/16/1989	12/21/1987
US	4,841,302	Henry	6/20/1989	1/30/1987
US	4,949,088	Ryan	8/14/1990	8/21/1989
US	5,146,226	Valentine	9/8/1992	4/18/1991
US	5,164,729	Decker	11/17/1992	10/5/1990
US	5,206,500	Decker	4/27/1993	5/28/1992
US	5,250,951	Valentine	10/5/1993	11/27/1992

[3] For patents, listed date is issue date unless otherwise noted.

US	5,300,932	Valentine	4/5/1994	7/20/1993
US	5,305,007	Orr	4/14/1994	4/13/1993
US	5,315,302	Katsukura	5/24/1994	11/12/1992
US	5,347,120	Decker	9/13/1994	4/27/1993
US	5,365,055	Decker	11/15/1994	4/27/1993
US	5,485,161	Vaughn	1/16/1996	11/21/1994
US	5,515,042	Nelson	5/7/1996	1/20/1995
US	5,530,447	Henderson	6/25/1996	1/13/1995
US	5,554,982	Shirkey	9/10/1996	8/1/1994
US	5,559,508	Orr	9/24/1996	8/10/1994
US	5,668,554	Orr	9/16/1997	9/23/1996
US	5,682,168	James	10/28/1997	5/20/1996
US	5,684,476	Anderson	11/4/1997	5/8/1995
US	5,781,145	Williams	7/14/1998	4/15/1996
US	5,793,476	Laakmann	8/11/1998	12/4/1995
US	5,835,052	Iwakuni	11/10/1998	8/14/1997
US	5,907,293	Tognazzini	5/25/1999	7/1/1996
US	5,977,884	Ross	11/2/1999	7/1/1998
US	6,118,403	Lang	9/12/2000	8/24/1999
US	6,169,511	Iwakuni	1/2/2001	8/18/1998
US	6,201,493	Silverman	3/13/2001	5/28/1999
US	6,246,948	Thakker	6/12/2001	12/10/1998
US	6,252,544	Hoffberg	6/26/2001	1/25/1999
US	6,285,317	Ong	9/4/2001	5/1/1998

US	6,384,776	Martin	5/7/2002	4/30/1999
US	6,392,661	Tankersley	5/21/2002	6/17/1999
US	6,449,540	Rayner	9/10/2002	9/25/2000
US	6,614,385	Kuhn	9/2/2003	12/17/2001
US	6,670,905	Orr	12/30/2003	6/14/2000
US	7,999,721	Orr	8/16/2011	8/20/2008
US	8,525,723	Orr	9/3/2013	10/29/2010
US	9,046,594	Orr	6/2/2015	8/29/2013
US	RE39,038	Fleming	3/28/2006	1/28/2003
US	RE40,653	Fleming	3/10/2009	8/2/2005
US	2001/0002451	Breed	5/31/2001	1/2/2001
US	2001/0006372	Lemelson	7/5/2001	12/20/2000
US	2001/0012775	Modzelesky	8/9/2001	3/2/2001
US	2002/0022927	Lemelson	2/21/2002	8/2/2001
US	2002/0133294	Farmakis	9/19/2002	11/6/2001
US	2003/0218562	Orr	11/27/2003	3/25/2003
US	2007/0120728	Orr	5/31/2007	8/29/2006
DE	3411832	Froehlich	11/12/1992	3/30/1984
EP	508,866	Keller	9/21/1994	4/3/1992
FR	2,776,778	Liabeuf	10/1/1999	3/31/1998
JP	01-260386	Sugawara	10/17/1989	4/11/1988
JP	55-013887	Fujiyama	1/31/1980	7/17/1978
JP	H9-27096	Murakami	1/28/1997	7/10/1995
KR	100669102B1	Kim	1/15/2007	12/14/2004

PCT	WO 00/77539	Orr	12/21/2000	6/14/2000
UK	GB 2,320,384	Molyneux-Berry	6/7/2000	12/10/1996
US	An Integrated INS/GPS Approach	Schwarz	November 1993	N/A
US	Knowledge, Use, and Invention	Orr	1996	N/A
US	The Electronics Handbook	Whitaker	1996	N/A
US	Uniden Radar Detectors	Uniden	1996	N/A
US	Webarchive of Valentine1.com	Valentine Research, Inc.	5/30/1998	N/A

2. Prior Art Systems and Methods

Defendant identifies the prior art systems and methods described in the patents, applications, and publications listed in Section 1 above as prior art systems and methods known, made, publicly used, sold, and/or offered for sale on, before, and/or after the respective publication dates of the listed patents, applications, and publications. These prior art systems and methods anticipate or render obvious one or more of the asserted claims under §§ 102(a), (b), (f), or (g) or § 103.

Although Defendant's investigation continues, information presently available indicates that each system or method was (1) known or used in this country before the alleged invention of the claimed subject matter of one or more of the patents in suit; (2) in public use or on sale in this country more than one year before the application of one or more of the patents in suit; or (3) invented by another who did not abandon, suppress, or conceal his invention before the alleged invention of the claimed subject matter of one or more of the Asserted Claims.

The following prior art systems and methods are discussed or identified in the prior art patent, patent applications, and/or publication references listed previously or in the charts accompanying these contentions. Defendant's investigation on these systems and methods is ongoing. Defendant continues to investigate the identities of the individuals or entities knowledgeable about, and/or involved in the sales, offers for sale, and/or public uses of these prior art systems and methods, and the precise dates that these systems and methods were first known, made, sold, offered for sale, and/or were publicly used. In addition, Defendant continues to investigate the dates of conception and reduction to practice of certain of these prior art systems and methods, and when the prior art systems and methods were first known, made, and/or used by others. Defendant reserves the right to supplement these contentions, if necessary, to provide additional information and/or rely on additional evidence about any of this prior art as new information becomes available.

The identification of prior art systems and methods below is exemplary. There may exist other prior art versions of the systems and methods identified below and Defendant reserves the right to rely on them during later proceedings. There may also exist multiple implementations for any particular version number or any particular dated version of a system or method, and Defendant likewise reserves the right to rely on them during later proceedings. Defendant reserves the right to amend or supplement these invalidity contentions, if necessary, and to rely on or refer to evidence of other versions of these systems or methods as discovery progresses.

Item	Date of Sale, Offer, or Public Availability	Person/Entity Making the Use Known
Knowledge, Use, and Invention	No later than 1996	Orr
Uniden Radar Detectors	No later than 1996	Uniden

Webarchive of Valentine1.com	No later than 5/30/1998	Valentine Research, Inc.

II. MISC. ORDER ¶ 3-3(A)(2) – ANTICIPATION AND OBVIOUSNESS GROUNDS

Pursuant to Misc. Order 62 ¶ 3-3(a)(2) and as shown in the Misc. Order 62 ¶ 3-3(a)(3) charts provided in Exhibits A–C, Defendant contends that certain prior art references below anticipate one or more Asserted Claims and that to the extent the identified prior art references do not anticipate the Asserted Claims, those claims are invalid as obvious under 35 U.S.C. § 103. Each anticipatory prior art reference disclosed, either alone or in combination with other prior art, also renders the Asserted Claims invalid as obvious. In particular, each anticipatory prior art reference may be combined with (1) information generally known to persons skilled in the art at the time of the alleged invention(s), and/or (2) any of the other anticipatory prior art references. To the extent that Escort contends that any of the anticipatory prior art fails to disclose one or more limitations of the Asserted Claims, Defendant contends that any difference between the reference and the corresponding patent claims would have been obvious to one of ordinary skill in the art. Thus, all anticipation allegations should be interpreted as both reflecting anticipation by the reference as well as invalidity due to single reference obviousness, to the extent that Escort contends that any limitation is missing.

As stated above, Defendant incorporates by reference all other invalidity contentions related to the Asserted Patents served on Escort or any of its predecessors-in-interest, whether past or future. In accordance with Misc. Order 62 ¶ 3-3(a)(2) and (3), prior art references anticipating the Asserted Claims under Escort's apparent claim constructions are evident based on whether a prior art reference cited in the Exhibits A–C claim charts is shown as disclosing each of the limitations recited in a given Asserted Claim.

In addition to certain claims being anticipated under Escort's apparent claim constructions as indicated above, the Asserted Claims are also invalid as obvious over the same teachings identified for anticipation. Further, the Asserted Claims are obvious over various combinations of the references shown in the claim charts accompanying or incorporated by reference into this disclosure. No Asserted Claim goes beyond combining known elements to achieve predictable results or does more than choose between clear alternatives known to those of skill in the art. Thus, to the extent that an Asserted Claim is not anticipated, it is nevertheless invalid as obvious. Specifically, Defendant asserts that any charted or incorporated reference in combination with one or more other charted or incorporated references renders the Asserted Claims obvious. In other words, to the extent a prior art reference identified in the Exhibits A–C claim charts is not shown as having disclosure for a particular claim limitation, Defendant contends that it would have at a minimum been obvious to combine that reference with one or more of the prior art references that are shown as disclosing that particular claim limitation.

In *KSR International Co. v. Teleflex, Inc.*, the United States Supreme Court held that, among other things, "[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." 127 S. Ct. 1727, 1731, 1739 (2007) ("[A] court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions."). In particular, a patent is obvious where "the content of the prior art, the scope of the patent claim, and the level of ordinary skill are not in material dispute, and the obviousness of the claim is apparent in light of these factors." *Id.* at 1745–46. The Supreme Court found that "if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the

same way, using the technique is obvious unless its actual application is beyond his or her skill." *Id.* at 1731.

Moreover, the Court recognizes that market pressures will motivate a person of ordinary skill to survey known art for solutions to problems. *Id.* at 1732 ("When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp."). When a person of ordinary skill uses an identified, predictable solution to solve a problem, "it is likely the product not of innovation but of ordinary skill and common sense." *Id.*

In addition, when a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. *Id.* at 1740. If a person of ordinary skill can implement a predictable variation, 35 U.S.C. § 103 bars its patentability. Id. The rationale to combine or modify prior art references is significantly stronger when references seek to solve similar problems, come from the same field, and correspond well. *In re Inland Steel Co.*, 265 F.3d 1354, 1362 (Fed. Cir. 2001).

Motivations to combine, as well as the general state of the art, may be found in a variety of places including the references defined above, and the specification of the Asserted Patents. For example, each piece of prior art generally relates to methods and/or systems for generating, suppressing, or modifying warnings to incoming signals including, but not limited to, law enforcement signals. A person of ordinary skill in the art at the time of the alleged invention would have been motivated to combine any one piece of identified prior art with any other identified piece of prior art. For at least this reason, it would have been obvious to a person of skill in the art at the time of the alleged invention(s) of the Asserted Claims to combine the various references

cited herein so as to practice the Asserted Claims and there is a motivation in the art to make such a combination.

Motivations to combine various prior art references are present in the references themselves, the common knowledge of one of ordinary skill in the art, the prior art as a whole, or the nature of the problems allegedly addressed by the Asserted Patents. Further reasons to combine the references identified in these charts include the nature of the problem being solved, the express, implied and inherent teachings of the prior art, the knowledge of persons of ordinary skill in the art, the fact that the prior art is generally directed towards methods and/or systems for generating, suppressing, or modifying warnings to incoming signals including, but not limited to, law enforcement signals, that such combinations would have yielded predictable results, and that such combinations would have represented known alternatives to a person of ordinary skill in the art.

To the extent not anticipated, the Asserted Claims represent no more than the result of ordinary innovation over the prior art. Moreover, no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of skill in the art. *See KSR*, 127 S. Ct. at 1739–40 (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 1742. Nevertheless, in keeping with Miscellaneous Order No. 62, and in addition to the information contained in the section immediately above and elsewhere in these contentions, additional motivation and reason to combine the cited art are identified. A person

having ordinary skill in any or all of these fields would be aware of all prior art in those fields, including but not limited to the identified prior art references and systems, and would have been motivated to combine the teachings of prior art with the field.

In sum, motivations to modify or combine the identified references including the references listed above can be found via, for example, discussions in the cited references, the state of the art discussed in the references, and the knowledge of one of ordinary skill in the art. One of ordinary skill in the art would have been motivated to combine these references, because these references relate to common objectives and subject matter. The references share commonalities in terms of their general subject matter as well as the types of equipment, products, systems, and/or methods used. Further, the prior art references explicitly or implicitly reference other prior art references, share common authors or inventors, were published in the same journals, presented at the same conferences, and/or were developed at common companies, schools, or organizations which would motivate one of skill in the art to combine them. These references are within the field of the Asserted Patents and are directed to similar subject matter within the field. Additionally, the references, and any products, devices, or processes described in the references, existed and/or were invented in the same time period providing further motivation for combination. These disclosures were provided without prejudice to any arguments or objections concerning the relevance of motivation to combine in connection with any invalidity contentions.

For example, such a person would have been motivated to combine one or more prior art references and/or activities described in these First Supplemental Preliminary Invalidity Contentions to:

- More efficiently, easily, cheaply, quickly, repeatedly, accurately, and/or reliably generate, suppress, or modify warnings to incoming signals including, but not limited to, law enforcement signals.
- Reduce difficulty, expense, time required, steps required, user interactions required, equipment required, and/or otherwise remove impediments to generating, suppressing, or modifying warnings to incoming signals including, but not limited to, law enforcement signals.

Additionally, Hoffberg describes a mobile communication device "including police radar and LIDAR detectors, user output, memory, central processor, GPS receiver and RF transceiver." Hoffberg at 24:29–32. For example, Hoffberg discloses a mobile communication device enabled to process current location information in conjunction with stored locations and associated events to determine a priority of the associated events. Specifically, Hoffberg discloses that its mobile communications device 1 can suppress false alarms by correlating detecting events with false alarm events stored in memory 4. *Id.* at 29:8–11, Fig. 1. It would have been obvious to one of ordinary skill in the art to combine the teachings of Hoffberg with any other reference herein. One of ordinary skill in the art would have been motivated to combine other disclosed prior art from these fields, including specifically the prior art identified herein, with the teachings of Hoffberg in order to, for example, "detect the event, e.g., radar signal, correlate it with a stored 'false alarm' event, and suppress an alarm or modify the alarm signal." *Id.*

In another example, Murakami describes radar detector that stores a location where a speed limit had been previously enforced and alerting the user when passing near or by that position again. Specifically, Murakami discloses that "when the user [asses by or near a location where enforcement is being performed which has been stored in the memory 5, the user is cautioned by

a warning sound or the like, and a visual warning is also given in the screen display . . . by displaying the location where the enforcement is being performed together with the map information in the navigation unit 3, thus preventing excess speed violation." Murakami at [0011]. It would have been obvious to one of ordinary skill in the art to combine the teachings of Murakami with any other reference herein. One of ordinary skill in the art would have been motivated to combine other disclosed prior art from these fields, including specifically the prior art identified herein, with the teachings of Murakami in order to, for example, prevent speeding citations by notifying the user when passing through a speeding enforcement area that he has previously passed through" *Id.* at [0004].

Further still, Kim describes a radar detector that includes, *inter alia*, a processor, storage unit, alarm, media player, and voice recorder. Specifically, Kim discloses that "the processor (400) includes USB controller or the IDE controller and it controls so that data transmission is made through this USB or IDE. In that way data transmission is administered between the apparatus including the storage unit (410) and computer etc." Kim, Structure & Operation of the Invention, ¶ 13. It would have been obvious to one of ordinary skill in the art to combine the teachings of Kim with any other reference herein. One of ordinary skill in the art would have been motivated to combine other disclosed prior art from these fields, including specifically the prior art identified herein, with the teachings of Kim in order to, for example, transmit data "between the apparatus including the storage unit (410) and computer etc." using a USB controller. *Id.*

Further still, U.S. Patent Application No. 2003/0218562A1 ("Orr '562") and U.S. Patent No. 6,670,905 ("Orr '905") disclose each asserted claim limitation in the '679 Patent either alone or in combination with any other references herein. In particular, the Orr '905 and/or Orr '562 references each describe a GPS-enabled radar detector that includes technology for determining

the location of the detector, and comparing this location to the locations of known Stationary Sources. *See, e.g.*, Orr ’905, 4:15-19. Both references also disclose that the radar detector “may ignore detections received in an area known to contain a Stationary Source, or may only ignore Specific frequencies or may handle frequencies differently based upon historic trends of spurious police radar signals at each frequency.” *See, e.g., id.*, Abstract. Both references further disclose a “Universal Serial Bus (USB) interface 46 that provides a means for uploading and downloading information to and from processor 22.” *See, e.g., id.*, 9:29-31.

Defendant reserves the right to further specify the motivations to combine the prior art in response to positions that Escort may take later in this case and as discovery, including third party discovery, proceeds. Defendant may rely on any and all portions of the prior art, other documents, and expert testimony to establish that a person of ordinary skill in the art would have been motivated to modify or combine the prior art so as to render the claims invalid as obvious.

Defendant may rely upon a subset of the references or all of the references depending upon the Court’s claim construction and further investigation. Defendant’s contention that the references in this section, in various combinations, render the Asserted Claims obvious under 35 U.S.C. § 103 are in no way an admission or suggestion that each reference does not independently anticipate the Asserted Claims under § 102. Any of the references disclosed herein may be combined with other references disclosed herein and/or with the knowledge of one of ordinary skill in the art during the relevant time period to render obvious, and therefore invalid, the Asserted Claims. These combinations are not intended to be exhaustive, as there are many possible combinations of the references listed herein and it is not practical, particularly at this early stage prior to further factual investigation and claim construction proceedings, to identify and list all potentially relevant

combinations. In particular, the Asserted Claims are rendered obvious under 35 U.S.C. § 103 in view of at least, and without limitation, the following:

III. MISC. ORDER ¶ 3-3(A)(3) – CLAIM CHARTS

Invalidity claim charts identifying disclosures in the references identified in Section II *supra* as to the Asserted Claims of the Asserted Patents are provided in attached Exhibit A ('038 Patent), Exhibit B ('653 Patent), and Exhibit C ('679 Patent).

Defendant has identified relevant portions and/or features of the prior art. However, the identified prior art may contain additional descriptions of or alternative support for the claim limitations. Defendant may rely on uncited portions or features of the identified prior art, other documents, and expert testimony, to provide context or to aid in understanding the identified prior art and the state of the art. Citations to a particular figure in a reference include the caption and description of the figure and any text relating to the figure. Similarly, citations to particular text referring to a figure include the figure and caption as well.

Throughout the invalidity claim chart Exhibits A–C, Defendant provides examples of where references disclose subject matter recited in preambles of the Asserted Claims, regardless whether the preambles limit the claims. Defendant reserves the right to argue that the preambles are or are not limitations. Further, where an entry in a claim chart corresponding to a given limitation refers back to the discussion of another claim, the entry incorporates all evidence cited for the other claim.

IV. MISC. ORDER ¶ 3-3(A)(4) – § 112 GROUNDS

As stated above, Defendant incorporates by reference all § 112-based invalidity contentions disclosed to Escort or any of its predecessors-in-interest, whether past or future. Specifically, for example, Defendant contends that the Asserted Claims of the Asserted Patents are invalid under pre-AIA 35 U.S.C. § 112, ¶ 1 for failing to enable or describe the claimed systems

and methods and/or pre-AIA 35 U.S.C. § 112, ¶ 2 as indefinite. S*ee, e.g., Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S. Ct. 2120, 2124 (2014). Where claim language is identified in connection with a pre-AIA 35 U.S.C. § 112 deficiency, Defendant reserves the right to focus on particular claim language within or surrounding the identified claim language to show the pre-AIA 35 U.S.C. § 112 deficiency.

Defendant contends that none of the Asserted Claims are entitled to claim priority to any previous application because they are not sufficiently described in or enabled by those applications. Defendant reserves the right to contest any priority dates and further reserve the right to allege additional invalidity grounds as appropriate. For example, many of the charted references qualify as prior art under § 102(e) under Escort's theory that the Asserted Claims of the '038 and '653 Patents are both entitled to a priority date of April 14, 1999. To the extent any of the Asserted Claims of the '038 and '653 Patents are entitled only to a later priority date (and is not invalid on some other ground) and a charted reference would qualify as prior art under § 102(b) based on that later date, Defendant reserves the right to contend invalidity based on that ground.

These contentions are subject to revision and amendment pursuant to Federal Rule of Civil Procedure 26(e) and the Orders of record in this matter to the extent appropriate, for example, in light of further investigation and discovery regarding the defenses, the Court's construction of the claims at issue, or review and analysis of expert witnesses. Defendant offers these contentions in response to Escort's infringement contentions and without prejudice to any position it may ultimately take as to any claim construction issues. To the extent these contentions reflect constructions of claim limitations consistent with or implicit in Escort's infringement contentions, no inference is intended nor should any be drawn that Defendant agrees with any claim

construction implied by Escort's infringement contentions, and Defendant expressly reserves the right to contest such claim constructions.

A. Enablement and Written Description Under Pre-AIA 35 U.S.C. § 112, ¶ 1

As Defendant best understands Escort's infringement contentions at this time, the Asserted Claims of the Asserted Patents are invalid because they fail to meet the "enablement" and "written description" requirements of pre-AIA 35 U.S.C. § 112, ¶ 1. The specifications of the Asserted Patents do not enable or describe the claimed systems and methods.

For example, the specification of the '038 Patent does not enable or describe the full scope of "generating an alert if the at least one characteristic is not similar to a predetermined characteristic," "operable to disable an alert to the incoming radar signal based at least in part upon the position of the radar detector," "operable to disable the alert based at least in part upon the velocity of the radar detector," "operable to disable the alert based at least in part upon the frequency of the incoming radar signal," and/or "operable to enable the alert based at least in part upon the frequency of the incoming radar signal."

Furthermore, the specification of the '653 Patent does not enable or describe the full scope of "data based at least in part upon," "muting an audible alert based upon data received from the button," "storing data in the non-volatile memory based upon data received from the button," "storing the second position in the non-volatile memory based at least in part upon data received from the button," "storing the second position and the frequency of the incoming radar signal in the non-volatile memory based upon data received from the button," "storing the second position and data related to the frequency of the incoming radar signal in the non-volatile memory based upon data received from the button," "storing data in the non-volatile memory based upon data received from the mute button," "storing the second position in the non-volatile memory based upon data received from the mute button," "storing the second position and the frequency of the

incoming radar signal in the non-volatile memory based upon data received from the mute button," "storing the second position and data related to the frequency of the incoming radar signal in the non-volatile memory based upon data received from the mute button," "performing an act that is unrelated to muting an alert based upon data received from the mute button," "storing the second position in the nonvolatile memory based upon first data received from the button," "performing an act that is unrelated to storing a position in the non-volatile memory based upon second data received from the button," "stores data in the non-volatile memory based upon data received from the button," "stores the second position and the frequency of the incoming radar signal in the non-volatile memory based upon data received from the button," "stores data in the non-volatile memory based upon data received from the mute button," "stores the second position in the non-volatile memory based upon data received from the mute button," "stores at least two items in the non-volatile memory based upon data received from the mute button," "performs an act that is unrelated to muting an alert based upon data received from the mute button," "stores data related to the second position in the non-volatile memory based upon first data received from the button," and/or "performing an act that is unrelated to storing a position in the non-volatile memory based upon second data received from the button."

Further still, the specification of the '679 Patent does not enable or describe the full scope of "a warning section responding to the receiver section and providing a warning if a received signal correlates to a law enforcement signal," "configurable in response to digital signals received via said digital interface connector," "receiving signals indicative of vehicle motion from a position determining circuit," "a warning section responding to a signal received by the receiver section greater than a threshold strength," "providing a warning if a received signal correlates to a

law enforcement signal," and/or "determining the threshold strength in relation to vehicle speed data and input from a user of the detector."

B. Indefiniteness Under Pre-AIA 35 U.S.C. § 112, ¶ 2

As Defendant best understands Escort's infringement contentions at this time, the Asserted Claims of the Asserted Patents are invalid because they fail to meet the "definiteness" requirement of pre-AIA 35 U.S.C. § 112, ¶ 2. Specifically, the language of the Asserted Claims fails to provide reasonable certainty as to the claims' scope, and the claims are therefore invalid under § 112, ¶ 2. *See Nautilus*, 134 S. Ct. at 2124 (holding that claims are indefinite when the specification and prosecution history "fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention").

Claims 42, 49, and 50 of the '038 Patent and the Asserted Claims of the '653 Patent are invalid under § 112, ¶ 2 for failure to particularly point out and distinctly claim performing various actions "based upon" or "based at least in part upon" certain data. The claims states that these various actions should be performed, but the specification fails to explain the manner or extent to which the performance of those actions should be based upon the cited data. Accordingly, the language of Claims 42, 49, and 50 of the '038 Patent and the Asserted Claims of the '653 Patent fails to provide reasonable certainty as to the claims' scope, and the claims are therefore invalid under § 112, ¶ 2. *See Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S. Ct. 2120, 2124 (2014) (holding that claims are indefinite when the specification and prosecution history "fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention"); *Interval Licensing LLC v. AOL, Inc.*, 766 F.3d 1364, 1370 (Fed Cir. 2014), *cert. denied*, 136 S. Ct. 59 (2015) ("Although absolute or mathematical precision is not required, it is not enough . . . to identify *some standard* for measuring the scope of the phrase.") (emphasis in original).

Claims	Term
’038 Patent, Claim 42	“generating an alert **based at least in part upon**”
’038 Patent, Claim 45[4]	“operable to disable an alert to the incoming radar signal **based at least in part upon**”
’038 Patent, Claims 49 and 50	“operable to [dis/en]able the alert **based at least in part upon**”
’653 Patent, Claims 22 and 38	“receiving [the] data **based at least in part upon**”
’653 Patent, Claims 25 and 41	“mut[ing/es] an audible alert **based upon** data received from the button”
’653 Patent, Claims 26, 30, 42, and 44	“stor[ing/es] data in the non-volatile memory **based upon** data received from the [mute] button”
’653 Patent, Claims 27, 31, and 45	“stor[ing/es] the second position in the non-volatile memory **based [at least in part] upon** data received from the [mute] button”
’653 Patent, Claims 28, 32, and 43	“stor[ing/es] the second position and the frequency of the incoming radar signal in the non-volatile memory **based upon** data received from the [mute] button”
’653 Patent, Claims 29 and 33	“storing the second position and data related to the frequency of the incoming radar signal in the non-volatile memory **based upon** data received from the [mute] button”
’653 Patent, Claims 34 and 47	“perform[s/ing] an act that is unrelated to muting an alert **based upon** data received from the mute button”
’653 Patent, Claim 46	“stores at least two items in the non-volatile memory **based upon** data received from the mute button”

At least the following claim terms/phrases are also indefinite:

- “predetermined distance” (’038 Patent, Claims 19, 23–25)
- “similar to” (’038 Patent, Claim 7)
- “determining the position of a radar detector” (’038 Patent, Claim 19)

[4] Claim 45 of the ’038 Patent was found invalid as anticipated in a prior litigation. *See Fleming v. Escort Inc.*, Case No. 1:09-cv-105 (D. Idaho), Defendant includes indefiniteness arguments pursuant to § 112, ¶ 2 regarding Claim 45 because Claims 49 and 50 (which Escort is asserting) depend from Claim 45.

- "determining the velocity of the device" ('038 Patent, Claim 21)
- "predetermined frequency range" ('038 Patent, Claims 23 and 24)
- "predetermined radar frequency" ('038 Patent, Claims 23 and 24)
- "the global positioning system receiver is operable to provide the microprocessor with data that indicates the velocity of the radar detector" ('038 Patent, Claim 29)
- "the global positioning system receiver is operable to provide the microprocessor with data that indicates the heading of the radar detector" ('038 Patent, Claim 30)
- "determining the distance between the position of the radar detector and another position" ('038 Patent, Claim 33)
- "determining the bearing between the position of the radar detector and another position" ('038 Patent, Claim 34)
- "the microprocessor is operable to disable the alert based at least in part upon the signal strength of the incoming radar signal" ('038 Patent, Claim 49)
- "the microprocessor is operable to enable the alert based at least in part upon the signal strength of the incoming radar signal" ('038 Patent, Claim 50)
- "police signal" ('679 Patent, Claims 28 and 40)
- "law enforcement signal" ('679 Patent, Claim 1)
- "being responsive to" ('679 Patent, Claim 1)
- "adapted to" ('679 Patent, Claims 28 and 40)
- "indicative of police activity" ('679 Patent, Claims 28 and 40)
- "signals generated in the context of law enforcement activity" ('679 Patent, Claim 1)
- "until at least said signals indicative of vehicle motion indicate vehicle motion over a distance" ('679 Patent, Claim 1)

V. ADDITIONAL INVALIDITY GROUNDS

The Asserted (and unasserted) Claims of the '038 Patent are invalid because they fail to satisfy 35 U.S.C. § 101's patentable subject matter requirement. The '038 Patent (i) is directed to an abstract idea of filtering information and (ii) fails to disclose an inventive concept that transforms the otherwise abstract idea into patent eligible subject matter. *Alice Corp. v. CLS Bank Int'l*, 134 S. Ct. 2347, 2555 (2014); *Bascom Glob. Internet Servs., Inc. v. AT&T Mobility LLC*, 827 F.3d 1341, 1348 (Fed. Cir. 2016). None of the claimed elements of the '038 Patent, considered both individually and as an ordered combination, transform the nature of the claims into a patent eligible application. Defendant incorporates by reference the § 101 arguments set forth in its Rule 12(b)(6) Motion to Dismiss. (*See* Dkt. No. 15.)

The Asserted (and unasserted) Claims of the ’653 Patent are invalid because they fail to satisfy 35 U.S.C. § 101’s patentable subject matter requirement. The ’653 Patent (i) is directed to an abstract idea of filtering information and (ii) fails to disclose an inventive concept that transforms the otherwise abstract idea into patent eligible subject matter. *Alice*, 134 S. Ct. at 2555; *Bascom*, 827 F.3d at 1348. None of the claimed elements of the ’653 Patent, considered both individually and as an ordered combination, transform the nature of the claims into a patent eligible application.

The Asserted (and unasserted) Claims of the ’679 Patent are invalid because they fail to satisfy 35 U.S.C. § 101’s patentable subject matter requirement. The ’679 Patent (i) is directed to an abstract idea of filtering information and (ii) fails to disclose an inventive concept that transforms the otherwise abstract idea into patent eligible subject matter. *Alice*, 134 S. Ct. at 2555; *Bascom*, 827 F.3d at 1348. None of the claimed elements of the ’679 Patent, considered both individually and as an ordered combination, transform the nature of the claims into a patent eligible application.

VI. ACCOMPANYING DOCUMENT PRODUCTION

Pursuant to Misc. Order 62 ¶ 3-4(b), Defendant has produced or is producing prior art references and corroborating evidence concerning prior art systems that do not appear in the file histories of the Asserted Patents. These prior art references and corroborating evidence are cited in and support the accompanying invalidity charts. Defendant’s search for prior art references, additional documentation, and/or corroborating evidence is ongoing. Accordingly, Defendant reserves the right to continue to supplement its production as it obtains additional prior art references, documentation, and/or corroborating evidence concerning invalidity during the course of discovery.

Dated: August 24, 2018

By: */s/ David B. Conrad*

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UNIDEN AMERICA CORPORATION

CERTIFICATE OF SERVICE

The undersigned hereby certifies that on August 24, 2018, all counsel of record who are deemed to have consented to electronic service are being served with a copy of this document via electronic mail.

/s/ David B. Conrad
David B. Conrad

EXHIBIT 2

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

ESCORT INC., **Plaintiff,** **v.** **UNIDEN AMERICA CORPORATION,** **Defendant.**	**CASE NO. 3:18-CV-161-N** **PATENT CASE** **JURY TRIAL DEMANDED**

UNIDEN'S PARAGRAPH 4-1(a) DISCLOSURES

Pursuant to Paragraph 4-1(a) of the Court's Amended Miscellaneous Order No. 62, Defendant Uniden America Corporation ("Uniden") makes the following disclosure of proposed claim terms and claim elements from U.S. Patent Nos. RE39,038 ("the '038 Patent"), RE40,653 (the "'653 Patent"), and 7,576,679 (the "'679 Patent") (collectively, the "Patents-in-Suit") for construction. Pursuant to Paragraph 4-1(b), Uniden is prepared to meet and confer with Plaintiff at a mutually agreeable time to combine and finalize the parties' respective lists of claim terms and claim elements to be construed and to facilitate the preparation of the Joint Claim Construction and Prehearing Statement for the Patents-in-Suit.

These proposed claim terms and claim elements are based on the asserted claims identified in Plaintiff's Paragraph 3-1 and 3-2 Disclosures. If other claims become relevant through information learned in discovery or otherwise, Uniden reserves the right to propose claim terms and claim elements for construction for, and in light of, such additional claims. In the instances in which Uniden identifies a phrase below as a proposed phrase for construction, Uniden identifies for potential construction both the words within the phrase (individually) and the phrase as a whole.

Uniden also reserves the right to contend that any of the terms or phrases listed herein additionally or alternatively render the claim or claims in which that term or phrase appears indefinite. Uniden also reserves the right to supplement, amend, and/or modify the following list of proposed claim terms and claim elements for claim construction to facilitate the ultimate preparation of the Joint Claim Construction and Pre-Hearing Statement.

<u>List of Proposed Claim Terms, Phrases and Clauses in the ’038 Patent for Construction</u>

1. “detected” (Claims 1, 11) / “utilized to detect” (Claim 21)

2. “determining the position of a radar detector” (claim 19)

3. “determining the velocity of the radar detector” (Claim 21)

4. “determining the distance between the position of the radar detector and another position” (Claim 33)

5. “determining the bearing between the position of the radar detector and another position.” (Claim 34)

6. “program storage device [*or* memory device] that is coupled to the microprocessor” (Claims 19, 21, 31, 33, 34, 35, 36, 38, 42)

7. “the global positioning system receiver is operable to provide the microprocessor with data that indicates the velocity of the radar detector.” (Claim 29). This element should be governed by 35 U.S.C. § 112(6).

8. “the global positioning system receiver is operable to provide the microprocessor with data that indicates the heading of the radar detector.” (Claim 30). This element should be governed by 35 U.S.C. § 112(6).

9. “the micro processor is operable to disable the alert based at least in part upon the signal strength of the incoming radar signal.” (Claim 49). This element should be governed by 35 U.S.C. § 112(6).

10. “the micro processor is operable to enable the alert based at least in part upon the signal strength of the incoming radar signal.” (Claim 50). This element should be governed by 35 U.S.C. § 112(6).

<u>List of Proposed Claim Terms, Phrases and Clauses in the ’653 Patent for Construction</u>

1. “[determining]/[determines] a first position of the radar detector” (Claim 22, 38)

2. "[determining]/[determines] a second position of the radar detector" (Claim 22, 38)

3. "the second position" (Claim 22, 27, 28, 29, 31, 32, 33, 38, 43, 45)

4. "receiving data based at least in part upon the second position" (Claim 22, 38)

5. "[based]/[based at least in part] upon data received from the [button]/[mute button]" (Claim 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 41, 42, 43, 44, 45, 46, 47)

6. "the button/a button" (Claims 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 41, 42, 43, 44, 45, 46, 47)

7. "data related to the frequency of the incoming radar signal" (Claim 29, 33)

8. "performing an act that is unrelated to muting an alert" (Claim 34, 47)

<u>List of Proposed Claim Terms, Phrases and Clauses in the '679 Patent for Construction</u>

1. "correlates to a law enforcement signal" (Claim 1)

2. "correlates to a police signal" (Claims 28, 40)

3. "speed determining circuit" (Claim 28)

4. "position determining circuit" (Claims 1, 12, 28, 33)

5. "warning suppression mode" (Claim 1)

6. "suppress" (Claim 1)

Dated: August 20, 2018

Respectfully submitted,

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a true and correct copy of the above and foregoing document has been served on August 20, 2018 to all counsel of record via electronic mail.

/s/ David B. Conrad
David B. Conrad

EXHIBIT 3

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

ESCORT INC., **Plaintiff,** **v.** **UNIDEN AMERICA CORPORATION,** **Defendant.**	**CIVIL ACTION NO. 3:18-cv-00161-N**

DEFENDANT'S PRELIMINARY INVALIDITY CONTENTIONS

Pursuant to ¶¶ 3-3 and 3-4 of Miscellaneous Order No. 62 ("Misc. Order 62"), Defendant Uniden America Corporation ("Defendant") hereby provides its Preliminary Invalidity Contentions, which include the accompanying claim charts, to Plaintiff Escort Inc. ("Escort").

As disclosed in its Misc. Order 62 ¶ 3-1 Disclosure of Asserted Claims and Preliminary Infringement Contentions served on Defendant, Escort asserts the following patents and claims:

Patents	Claim(s)
U.S. Patent No. RE39,038	7, 9, 11–14, 16, 19–21, 23–24, 27, 29–31, 33–36, 38, 41–42 and 49–50
U.S. Patent No. RE40,653	22, 25–34, 36–38, 41–47 and 49–50
U.S. Patent No. 7,576,679	1–3, 10–12, 28–33 and 40–43

The patents identified above are together herein referred to as "the Asserted Patents," and the claims identified above are together herein referred to as "the Asserted Claims" unless reference is made specifically with respect to particularly identified one or more of the Asserted Patents and/or one or more of the Asserted Claims.

Defendant hereby: (a) identifies each currently known item of prior art that either anticipates or renders any Asserted Claim obvious; (b) specifies whether each such item of prior art anticipates any Asserted Claim or whether an item of prior art, either alone or in combination with other items of prior art, renders any Asserted Claim obvious; (c) submits charts identifying where each element in the Asserted Claims is disclosed, described, or taught in the prior art; (d) identifies the grounds for invalidating the Asserted Claims based on indefiniteness under 35 U.S.C. § 112, ¶ 2, or enablement or written description under 35 U.S.C. § 112, ¶ 1; and (e) preliminarily identifies such additional grounds for invalidity of the Asserted Claims as are presently known.

As further detailed in and supported by these Invalidity Contentions, Defendant contends that each of the Asserted Claims is invalid under at least 35 U.S.C. §§ 101, 102, 103, and/or 112. Defendant reserves the right to prove the invalidity of the Asserted Claims on bases other than those required to be disclosed in these disclosures pursuant to Misc. Order 62 ¶ 3-3.

In addition, pursuant to Misc. Order 62 ¶ 3-4(a) and (b) and based on its investigation to date, Defendant has produced or hereby produces documents currently in its possession, custody, or control required to accompany these Invalidity Contentions. Defendant reserves the right to supplement this production during the course of discovery as any additional relevant materials are located.

Consistent with Misc. Order 62 ¶ 3-6, Defendant reserves the right to amend these Invalidity Contentions. The information and documents that Defendant produces are provisional and subject to further revision. Defendant expressly reserves the right to amend the disclosures and document production herein should Escort provide any information that it failed to provide in its Misc. Order 62 ¶ 3-1 and 3-2 disclosures, produce additional prior art, or amend its Misc. Order 62 ¶ 3-1 or 3-2 disclosures in any way.

Further, because discovery has not closed and because Defendant has not yet completed its search for and analysis of relevant prior art, Defendant reserves the right to revise, amend, and/or supplement the information provided herein, including identifying and relying on additional references, should Defendant's further search and analysis yield additional information or references, consistent with Miscellaneous Order No. 62 and the Federal Rules of Civil Procedure. Moreover, Defendant reserves the right to revise its ultimate contentions concerning the invalidity of the Asserted Claims, which may change depending upon the Court's construction of the Asserted Claims, any findings as to the priority date of the Asserted Claims, and/or positions that Escort or its expert witness(es) may take concerning claim construction, infringement, and/or invalidity issues.

Prior art not included in this disclosure, whether known or not known to Defendant, may become relevant. In particular, Defendant is currently unaware of the extent, if any, to which Escort will contend that limitations of the Asserted Claims are not disclosed in the prior art identified by Defendant. To the extent that such an issue arises, Defendant reserves the right to identify other well-known components or references that *inter alia* would have made the addition of the allegedly missing limitation to the disclosed device or method obvious. In other words, Defendant reserves the right to identify other references that would disclose the allegedly missing limitation(s) of the claimed method, device, or system.

Defendant's claim charts cite to particular teachings and disclosures of the prior art as applied to features of the Asserted Claims. The cited portions are only examples, and Defendant reserves the right to rely on uncited portions of the prior art references. In addition, if helpful, Defendant may point to other publications as aids in understanding and interpreting the cited prior art references, by for example, providing context to show how one of ordinary skill in the art would

interpret a portion of a prior art reference. Defendant further reserves the right to rely on any evidence or prior art included in its production, UNIDEN_0000401 – UNIDEN_0001591, whether or not it is charted.

In addition to the positions and prior art identified below and the accompanying invalidity claim charts, Defendant also incorporates by reference all invalidity contentions, prior art, and invalidity claim charts (including, without limitation, all anticipation positions, obviousness positions (including all prior art combinations and motivations to combine), indefiniteness positions, and enablement positions) disclosed at any time – regardless of whether in the past or future, regardless of whether in formal litigation – to Escort, Escort's attorneys or representatives, any one or more of the named inventors, individuals associated with prior owners and assignees of one or more of the Asserted Patents, individuals and entities associated with the prosecution of one or more of the Asserted Patents, and/or Escort's affiliates in connection with one or more of the Asserted Patents, including but not limited to disclosures or statements by entities that Escort has sued, entities that Escort has threatened to sue or otherwise sought out by Escort for licensing purposes, the U.S. Patent and Trademark Office, and foreign patent offices. These proceedings include but are not limited to the following litigations and patent office proceedings: *Fleming v. Escort Inc.*, Case No. 1:09-cv-105 (D. Idaho); *Fleming v. Escort Inc.*, Case No. 1:12-cv-66 (D. Idaho); *Fleming v. Cobra Elecs. Corp.*, Case No. 1:12-cv-392 (D. Idaho); *Fleming v. Escort Inc.*, Case No. 1:15-cv-542 (D. Idaho); and *Escort Inc. v. noLimits Enterprises, Inc.*, Case No. 1:18-cv-323 (S.D. Ohio). Defendant further incorporates by reference IPR2013-00203 and IPR2013-00240 which relate to subject matter disclosed in the '679 Patent. As stated above, those prior invalidity contentions, claim charts, prior art, and related documents are incorporated herein by

reference as if being set forth in at least the same level of detail herein as previously provided to Escort.

Further, Defendant incorporates, in full, all prior art references cited in the Asserted Patents and any patents to which the Asserted Patents claim priority, and the Asserted Patents' respective prosecution histories.

These Invalidity Contentions are based on Defendant's current understanding of the Asserted Claims and Escort's apparent view of the scope of those claims as shown, for example, in its Infringement Contentions. A *Markman* Order in this case has not yet been issued, and in no way shall these Invalidity Contentions be taken as any admission or acquiescence by Defendant as to the proper scope of the Asserted Claims and/or proper claim constructions of terms and phrases recited in those claims. By identifying prior art that anticipates and/or renders obvious the Asserted Claims, Defendant does not admit that the claim limitations are capable of construction and do not adopt Escort's apparent claim constructions or admit the accuracy of any particular claim construction.[1] Defendant reserves all rights to later challenge or oppose any claim constructions advanced by Escort and to present claim its own claim construction positions.

[1] Defendant does not concede that Escort's constructions are correct, but rather assert the well-established principle that whatever infringes a claim if later in time anticipates if earlier in time. *Bristol-Myers Squibb Co. v. Ben Venue Labs., Inc.*, 246 F.3d 1368, 1378 (Fed. Cir. 2001). Thus, where Escort for purposes of its infringement case alleges that a feature of an accused product meets a particular limitation recited in one or more of the Asserted Claims, then that feature, should it be found in the prior art, would also cause that limitation to be met for invalidity purposes.

Indeed, Defendant contends that Escort is accusing Defendant of infringement based on the same functionality that was well known and disclosed in the prior art, as exemplified by the following prior art disclosure (Second Declaration of Steven K. Orr Under 37 C.F.R. § 1.131, dated August 19, 2005, ¶ 4):

> Prior to January 27, 1998, I created a family of tools for collecting field data from a radar detector, so that data could be stored from each radar encounter of the detector. The system involved a radar detector cabled (via fiber optics) to a laptop's

Nothing stated herein shall be treated as an admission or suggestion that Defendant agrees with Escort regarding either the scope of any of the Asserted Claims or the apparent claim constructions advanced by it in its Infringement Contentions or anywhere else. Moreover, nothing in these Invalidity Contentions shall be treated as an admission that Defendant's accused technology meets any limitations of the Asserted Claims.

Nothing stated herein shall be construed as an admission or a waiver of any particular construction of any claim term. Defendant also reserves all rights to challenge any of the claim terms herein under 35 U.S.C. § 112 including by arguing that they are indefinite, not supported by the written description and/or not enabled. Accordingly, nothing stated herein shall be construed as a waiver of any argument available under 35 U.S.C. § 112.

Defendant further reserves the right to revise these Invalidity Contentions in view of the Court's construction of terms and phrases recited in one or more of the Asserted Claims, additional information obtained during discovery, additional infringement theories put forth by Escort during fact and/or expert discovery, any findings as to the priority date(s) of the Asserted Claims,[2] and/or positions that Escort, its fact witnesses, or its expert witness(es) may take concerning claim construction, infringement, and/or invalidity issues.

> COM port. When the detector encountered a radar signal sufficient for an alert, spectral information and the band of the encountered radar signal were recorded by the laptop computer, which also emitted an audible "beep."

[2] In an abundance of caution, Defendant has identified prior art based on Escort's alleged priority date for the '038 and '653 Patents as April 14, 1999. However, the '038 Patent matured from a reissue application filed on January 28, 2003, and the '653 Patent matured from a continuation of that application. Thus, to the extent the Asserted Claims of the '038 and '653 Patents are determined to have been impermissibly broadened in the reissue applications, Defendant reserves the right to identify additional prior art based on a later priority date.

Defendant further reserves the right to supplement its accompanying Misc. Order 62 ¶ 3-4(b) document production should it later discover additional prior art documents, information, testimony, prior art systems and related documentation, and/or software or hardware code, including information provided by third parties after the date of service of these Invalidity Contentions.

Defendant may further rely on inventor admissions concerning the scope or state of the prior art relevant to the Asserted Claims, the patent prosecution histories of the Asserted Patents, related patents and/or patent applications, any deposition or trial testimony of the named inventor on the Asserted Patents, and the papers filed and any evidence produced or submitted by Escort in connection with these cases or other related litigation. Defendant reserves the right to contend that one or more of the Asserted Claims are invalid under 35 U.S.C. § 102(f) in the event that they obtain evidence that the named inventors did not invent the subject matter in the Asserted Claims.

The references identified in these Invalidity Contentions, which include the attached claim charts, may disclose the elements of the Asserted Claims explicitly and/or inherently, and/or they may be relied upon to show the state of the art in the relevant time frame. References identified in these Invalidity Contentions, as well as the "References Cited" on the face of the Asserted Patents and the patents cited within the body of the Asserted Patents, may be used to illustrate, but not limit the scope of, the state of the art to which the Asserted Patents pertain (i.e., at a time prior to the date of alleged inventions of the Asserted Claims of the Asserted Patents). Moreover, Defendant reserves the ability to rely on later identified sources of information, including but not limited to witness testimony and other discovery, to establish the state of the art in the relevant time frame pertaining to the Asserted Patents.

Because discovery has just recently begun, Defendant anticipates that additional prior art and invalidity bases may be found. Defendant's investigation and analysis of the prior art is continuing, and thus Defendant reserves the right to supplement, amend, and/or revise the information provided herein as Defendant conducts further investigation and/or analysis, including identifying, charting, and relying on additional references.

Additionally, in view of likely third-party discovery that will be taken, Defendant reserves the right to present additional items of prior art under 35 U.S.C. §§ 102(a), (b), (e), and/or (g) and/or § 103 located during discovery or further investigation, and to assert contentions of invalidity under 35 U.S.C. §§ 102(c), (d), or (f). For example, Defendant expects to issue subpoenas to third parties believed to have knowledge, documents, and/or other evidence concerning invalidity of one or more of the Asserted Claims.

I. MISC. ORDER ¶ 3-3(A)(1) – IDENTIFICATION OF PRIOR ART

A. Admissions

By way of example only, the Asserted Patents admit that various problems were well known in the prior art, as well as systems and methods for addressing those problems. Examples of these acknowledged problems, systems, and methods serve as secondary reference(s) for obviousness combinations or as motivation(s) to combine two or more references. The "Background of the Invention" sections (and any other portions describing the state of the art or prior art) of the Asserted Patents shall be taken as admissions by Escort of content known in the prior art. Such prior art content is hereby incorporated by reference.

B. Prior Art

Pursuant to Misc. Order 62 ¶ 3-3(a)(1), and subject to Defendant's reservation of rights, Defendant identifies in the table below each item of prior art that anticipates or renders obvious the Asserted Claims. Again, to be clear, Defendant's identification of prior art incorporates by

reference and includes all prior art and invalidity grounds previously disclosed to Escort in other proceedings or instances, at any time.

Prior art under 35 U.S.C. §102(b) is identified by specifying the item offered for sale or publicly used or known, the date the offer or use took place or the information became known, and the identity of the person or entity which made the use or made and received the offer, or the person or entity which made the information known or to whom it was made known.

Prior art under 35 U.S.C. §102(f) is identified by providing the names of the person(s), if known, or other identifying information, if not known, from whom, and the circumstances under which the invention or any part of it was derived.

Defendant further intends to rely on inventor admissions concerning the scope of relevant prior art, the patent prosecution history for the Asserted Patents and related patents and/or patent applications, any deposition testimony of the named inventors listed on the Asserted Patents, and the papers filed and any evidence submitted by Escort or any of its predecessors-in-interest in conjunction with this litigation or other proceedings involving one or more of the Asserted Patents.

1. Prior Art Patents, Published Patent Applications, and Publications

Defendant identifies the following patents, published patent applications, and publications as prior art that anticipates and/or renders obvious one or more of the asserted claims under pre-AIA 35 U.S.C. §§ 102(a), (b), (e), or (g), or § 103. Certain prior art patents, patent applications, and/or publications identified below describe or are otherwise associated with corresponding prior art systems or methods. Defendant may rely on these patents, applications, and publications to provide evidence or corroboration of prior use, sale, offers for sale, knowledge, and/or invention under the provisions of pre-AIA 35 U.S.C. § 102. In addition, Defendant may also rely on each prior art patent, application, and publication as an independent basis for invalidity separate and

distinct from reliance upon any corresponding prior art system, method, or other related publications, patents, and patent applications.

Country	Patent No. or Title / System Name	Primary Inventor / Author	Date of Issue[3] / Publication / Date of Sale, Offer, or Public Availability	Filing Date
US	4,581,769	Grimsley	4/8/1986	1/31/1984
US	4,622,553	Baba	11/11/1986	9/20/1984
US	4,631,542	Grimsley	12/23/1986	9/28/1984
US	4,698,632	Baba	10/6/1987	6/19/1985
US	4,709,407	Baba	11/24/1987	10/1/1985
US	4,750,215	Biggs	6/7/1988	6/24/1986
US	4,791,420	Baba	12/13/1988	12/29/1987
US	4,817,000	Eberhardt	3/28/1989	3/10/1986
US	4,831,498	Baba	5/16/1989	12/21/1987
US	4,841,302	Henry	6/20/1989	1/30/1987
US	4,949,088	Ryan	8/14/1990	8/21/1989
US	5,146,226	Valentine	9/8/1992	4/18/1991
US	5,164,729	Decker	11/17/1992	10/5/1990
US	5,206,500	Decker	4/27/1993	5/28/1992
US	5,250,951	Valentine	10/5/1993	11/27/1992
US	5,300,932	Valentine	4/5/1994	7/20/1993
US	5,305,007	Orr	4/14/1994	4/13/1993
US	5,315,302	Katsukura	5/24/1994	11/12/1992

[3] For patents, listed date is issue date unless otherwise noted.

US	5,347,120	Decker	9/13/1994	4/27/1993
US	5,365,055	Decker	11/15/1994	4/27/1993
US	5,485,161	Vaughn	1/16/1996	11/21/1994
US	5,515,042	Nelson	5/7/1996	1/20/1995
US	5,530,447	Henderson	6/25/1996	1/13/1995
US	5,554,982	Shirkey	9/10/1996	8/1/1994
US	5,559,508	Orr	9/24/1996	8/10/1994
US	5,668,554	Orr	9/16/1997	9/23/1996
US	5,682,168	James	10/28/1997	5/20/1996
US	5,684,476	Anderson	11/4/1997	5/8/1995
US	5,781,145	Williams	7/14/1998	4/15/1996
US	5,793,476	Laakmann	8/11/1998	12/4/1995
US	5,835,052	Iwakuni	11/10/1998	8/14/1997
US	5,907,293	Tognazzini	5/25/1999	7/1/1996
US	5,977,884	Ross	11/2/1999	7/1/1998
US	6,118,403	Lang	9/12/2000	8/24/1999
US	6,169,511	Iwakuni	1/2/2001	8/18/1998
US	6,201,493	Silverman	3/13/2001	5/28/1999
US	6,246,948	Thakker	6/12/2001	12/10/1998
US	6,252,544	Hoffberg	6/26/2001	1/25/1999
US	6,285,317	Ong	9/4/2001	5/1/1998
US	6,384,776	Martin	5/7/2002	4/30/1999
US	6,392,661	Tankersley	5/21/2002	6/17/1999
US	6,449,540	Rayner	9/10/2002	9/25/2000

US	6,614,385	Kuhn	9/2/2003	12/17/2001
US	6,670,905	Orr	12/30/2003	6/14/2000
US	7,999,721	Orr	8/16/2011	8/20/2008
US	8,525,723	Orr	9/3/2013	10/29/2010
US	9,046,594	Orr	6/2/2015	8/29/2013
US	RE39,038	Fleming	3/28/2006	1/28/2003
US	RE40,653	Fleming	3/10/2009	8/2/2005
US	2001/0002451	Breed	5/31/2001	1/2/2001
US	2001/0006372	Lemelson	7/5/2001	12/20/2000
US	2001/0012775	Modzelesky	8/9/2001	3/2/2001
US	2002/0022927	Lemelson	2/21/2002	8/2/2001
US	2002/0133294	Farmakis	9/19/2002	11/6/2001
US	2003/0218562	Orr	11/27/2003	3/25/2003
US	2007/0120728	Orr	5/31/2007	8/29/2006
DE	3411832	Froehlich	11/12/1992	3/30/1984
EP	508,866	Keller	9/21/1994	4/3/1992
FR	2,776,778	Liabeuf	10/1/1999	3/31/1998
JP	01-260386	Sugawara	10/17/1989	4/11/1988
JP	55-013887	Fujiyama	1/31/1980	7/17/1978
JP	H9-27096	Murakami	1/28/1997	7/10/1995
KR	100669102B1	Kim	1/15/2007	12/14/2004
PCT	WO 00/77539	Orr	12/21/2000	6/14/2000
UK	GB 2,320,384	Molyneux-Berry	6/7/2000	12/10/1996
US	An Integrated INS/GPS Approach	Schwarz	November 1993	N/A

US	Knowledge, Use, and Invention	Orr	1996	N/A
US	The Electronics Handbook	Whitaker	1996	N/A
US	Uniden Radar Detectors	Uniden	1996	N/A
US	Webarchive of Valentine1.com	Valentine Research, Inc.	5/30/1998	N/A

2. Prior Art Systems and Methods

Defendant identifies the prior art systems and methods described in the patents, applications, and publications listed in Section 1 above as prior art systems and methods known, made, publicly used, sold, and/or offered for sale on, before, and/or after the respective publication dates of the listed patents, applications, and publications. These prior art systems and methods anticipate or render obvious one or more of the asserted claims under §§ 102(a), (b), (f), or (g) or § 103.

Although Defendant's investigation continues, information presently available indicates that each system or method was (1) known or used in this country before the alleged invention of the claimed subject matter of one or more of the patents in suit; (2) in public use or on sale in this country more than one year before the application of one or more of the patents in suit; or (3) invented by another who did not abandon, suppress, or conceal his invention before the alleged invention of the claimed subject matter of one or more of the Asserted Claims.

The following prior art systems and methods are discussed or identified in the prior art patent, patent applications, and/or publication references listed previously or in the charts accompanying these contentions. Defendant's investigation on these systems and methods is ongoing. Defendant continues to investigate the identities of the individuals or entities knowledgeable about, and/or involved in the sales, offers for sale, and/or public uses of these prior

art systems and methods, and the precise dates that these systems and methods were first known, made, sold, offered for sale, and/or were publicly used. In addition, Defendant continues to investigate the dates of conception and reduction to practice of certain of these prior art systems and methods, and when the prior art systems and methods were first known, made, and/or used by others. Defendant reserves the right to supplement these contentions, if necessary, to provide additional information and/or rely on additional evidence about any of this prior art as new information becomes available.

The identification of prior art systems and methods below is exemplary. There may exist other prior art versions of the systems and methods identified below and Defendant reserves the right to rely on them during later proceedings. There may also exist multiple implementations for any particular version number or any particular dated version of a system or method, and Defendant likewise reserves the right to rely on them during later proceedings. Defendant reserves the right to amend or supplement these invalidity contentions, if necessary, and to rely on or refer to evidence of other versions of these systems or methods as discovery progresses.

Item	Date of Sale, Offer, or Public Availability	Person/Entity Making the Use Known
Knowledge, Use, and Invention	No later than 1996	Orr
Uniden Radar Detectors	No later than 1996	Uniden
Webarchive of Valentine1.com	No later than 5/30/1998	Valentine Research, Inc.

II. MISC. ORDER ¶ 3-3(A)(2) – ANTICIPATION AND OBVIOUSNESS GROUNDS

Pursuant to Misc. Order 62 ¶ 3-3(a)(2) and as shown in the Misc. Order 62 ¶ 3-3(a)(3) charts provided in Exhibits A–C, Defendant contends that certain prior art references below anticipate one or more Asserted Claims and that to the extent the identified prior art references do

not anticipate the Asserted Claims, those claims are invalid as obvious under 35 U.S.C. § 103. Each anticipatory prior art reference disclosed, either alone or in combination with other prior art, also renders the Asserted Claims invalid as obvious. In particular, each anticipatory prior art reference may be combined with (1) information generally known to persons skilled in the art at the time of the alleged invention(s), and/or (2) any of the other anticipatory prior art references. To the extent that Escort contends that any of the anticipatory prior art fails to disclose one or more limitations of the Asserted Claims, Defendant contends that any difference between the reference and the corresponding patent claims would have been obvious to one of ordinary skill in the art. Thus, all anticipation allegations should be interpreted as both reflecting anticipation by the reference as well as invalidity due to single reference obviousness, to the extent that Escort contends that any limitation is missing.

As stated above, Defendant incorporates by reference all other invalidity contentions related to the Asserted Patents served on Escort or any of its predecessors-in-interest, whether past or future. In accordance with Misc. Order 62 ¶ 3-3(a)(2) and (3), prior art references anticipating the Asserted Claims under Escort's apparent claim constructions are evident based on whether a prior art reference cited in the Exhibits A–C claim charts is shown as disclosing each of the limitations recited in a given Asserted Claim.

In addition to certain claims being anticipated under Escort's apparent claim constructions as indicated above, the Asserted Claims are also invalid as obvious over the same teachings identified for anticipation. Further, the Asserted Claims are obvious over various combinations of the references shown in the claim charts accompanying or incorporated by reference into this disclosure. No Asserted Claim goes beyond combining known elements to achieve predictable results or does more than choose between clear alternatives known to those of skill in the art. Thus,

to the extent that an Asserted Claim is not anticipated, it is nevertheless invalid as obvious. Specifically, Defendant asserts that any charted or incorporated reference in combination with one or more other charted or incorporated references renders the Asserted Claims obvious. In other words, to the extent a prior art reference identified in the Exhibits A–C claim charts is not shown as having disclosure for a particular claim limitation, Defendant contends that it would have at a minimum been obvious to combine that reference with one or more of the prior art references that are shown as disclosing that particular claim limitation.

In *KSR International Co. v. Teleflex, Inc.*, the United States Supreme Court held that, among other things, "[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." 127 S. Ct. 1727, 1731, 1739 (2007) ("[A] court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions."). In particular, a patent is obvious where "the content of the prior art, the scope of the patent claim, and the level of ordinary skill are not in material dispute, and the obviousness of the claim is apparent in light of these factors." *Id.* at 1745–46. The Supreme Court found that "if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill." *Id.* at 1731.

Moreover, the Court recognizes that market pressures will motivate a person of ordinary skill to survey known art for solutions to problems. *Id.* at 1732 ("When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp."). When a person of ordinary skill uses an identified, predictable solution

to solve a problem, "it is likely the product not of innovation but of ordinary skill and common sense." *Id.*

In addition, when a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. *Id.* at 1740. If a person of ordinary skill can implement a predictable variation, 35 U.S.C. § 103 bars its patentability. Id. The rationale to combine or modify prior art references is significantly stronger when references seek to solve similar problems, come from the same field, and correspond well. *In re Inland Steel Co.*, 265 F.3d 1354, 1362 (Fed. Cir. 2001).

Motivations to combine, as well as the general state of the art, may be found in a variety of places including the references defined above, and the specification of the Asserted Patents. For example, each piece of prior art generally relates to methods and/or systems for generating, suppressing, or modifying warnings to incoming signals including, but not limited to, law enforcement signals. A person of ordinary skill in the art at the time of the alleged invention would have been motivated to combine any one piece of identified prior art with any other identified piece of prior art. For at least this reason, it would have been obvious to a person of skill in the art at the time of the alleged invention(s) of the Asserted Claims to combine the various references cited herein so as to practice the Asserted Claims and there is a motivation in the art to make such a combination.

Motivations to combine various prior art references are present in the references themselves, the common knowledge of one of ordinary skill in the art, the prior art as a whole, or the nature of the problems allegedly addressed by the Asserted Patents. Further reasons to combine the references identified in these charts include the nature of the problem being solved, the express, implied and inherent teachings of the prior art, the knowledge of persons of ordinary skill in the

art, the fact that the prior art is generally directed towards methods and/or systems for generating, suppressing, or modifying warnings to incoming signals including, but not limited to, law enforcement signals, that such combinations would have yielded predictable results, and that such combinations would have represented known alternatives to a person of ordinary skill in the art.

To the extent not anticipated, the Asserted Claims represent no more than the result of ordinary innovation over the prior art. Moreover, no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of skill in the art. *See KSR*, 127 S. Ct. at 1739–40 (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 1742. Nevertheless, in keeping with Miscellaneous Order No. 62, and in addition to the information contained in the section immediately above and elsewhere in these contentions, additional motivation and reason to combine the cited art are identified. A person having ordinary skill in any or all of these fields would be aware of all prior art in those fields, including but not limited to the identified prior art references and systems, and would have been motivated to combine the teachings of prior art with the field.

In sum, motivations to modify or combine the identified references including the references listed above can be found via, for example, discussions in the cited references, the state of the art discussed in the references, and the knowledge of one of ordinary skill in the art. One of ordinary skill in the art would have been motivated to combine these references, because these references

relate to common objectives and subject matter. The references share commonalities in terms of their general subject matter as well as the types of equipment, products, systems, and/or methods used. Further, the prior art references explicitly or implicitly reference other prior art references, share common authors or inventors, were published in the same journals, presented at the same conferences, and/or were developed at common companies, schools, or organizations which would motivate one of skill in the art to combine them. These references are within the field of the Asserted Patents and are directed to similar subject matter within the field. Additionally, the references, and any products, devices, or processes described in the references, existed and/or were invented in the same time period providing further motivation for combination. These disclosures were provided without prejudice to any arguments or objections concerning the relevance of motivation to combine in connection with any invalidity contentions.

For example, such a person would have been motivated to combine one or more prior art references and/or activities described in these Invalidity Contentions to:

- More efficiently, easily, cheaply, quickly, repeatedly, accurately, and/or reliably generate, suppress, or modify warnings to incoming signals including, but not limited to, law enforcement signals.
- Reduce difficulty, expense, time required, steps required, user interactions required, equipment required, and/or otherwise remove impediments to generating, suppressing, or modifying warnings to incoming signals including, but not limited to, law enforcement signals.

Additionally, Hoffberg describes a mobile communication device "including police radar and LIDAR detectors, user output, memory, central processor, GPS receiver and RF transceiver." Hoffberg at 24:29–32. For example, Hoffberg discloses a mobile communication device enabled

to process current location information in conjunction with stored locations and associated events to determine a priority of the associated events. Specifically, Hoffberg discloses that its mobile communications device 1 can suppress false alarms by correlating detecting events with false alarm events stored in memory 4. *Id.* at 29:8–11, Fig. 1. It would have been obvious to one of ordinary skill in the art to combine the teachings of Hoffberg with any other reference herein. One of ordinary skill in the art would have been motivated to combine other disclosed prior art from these fields, including specifically the prior art identified herein, with the teachings of Hoffberg in order to, for example, "detect the event, e.g., radar signal, correlate it with a stored 'false alarm' event, and suppress an alarm or modify the alarm signal." *Id.*

In another example, Murakami describes radar detector that stores a location where a speed limit had been previously enforced and alerting the user when passing near or by that position again. Specifically, Murakami discloses that "when the user [asses by or near a location where enforcement is being performed which has been stored in the memory 5, the user is cautioned by a warning sound or the like, and a visual warning is also given in the screen display . . . by displaying the location where the enforcement is being performed together with the map information in the navigation unit 3, thus preventing excess speed violation." Murakami at [0011]. It would have been obvious to one of ordinary skill in the art to combine the teachings of Murakami with any other reference herein. One of ordinary skill in the art would have been motivated to combine other disclosed prior art from these fields, including specifically the prior art identified herein, with the teachings of Murakami in order to, for example, prevent speeding citations by notifying the user when passing through a speeding enforcement area that he has previously passed through" *Id.* at [0004].

Further still, Kim describes a radar detector that includes, *inter alia*, a processor, storage unit, alarm, media player, and voice recorder. Specifically, Kim discloses that "the processor (400) includes USB controller or the IDE controller and it controls so that data transmission is made through this USB or IDE. In that way data transmission is administered between the apparatus including the storage unit (410) and computer etc." Kim, Structure & Operation of the Invention, ¶ 13. It would have been obvious to one of ordinary skill in the art to combine the teachings of Kim with any other reference herein. One of ordinary skill in the art would have been motivated to combine other disclosed prior art from these fields, including specifically the prior art identified herein, with the teachings of Kim in order to, for example, transmit data "between the apparatus including the storage unit (410) and computer etc." using a USB controller. *Id.*

Defendant reserves the right to further specify the motivations to combine the prior art in response to positions that Escort may take later in this case and as discovery, including third party discovery, proceeds. Defendant may rely on any and all portions of the prior art, other documents, and expert testimony to establish that a person of ordinary skill in the art would have been motivated to modify or combine the prior art so as to render the claims invalid as obvious.

Defendant may rely upon a subset of the references or all of the references depending upon the Court's claim construction and further investigation. Defendant's contention that the references in this section, in various combinations, render the Asserted Claims obvious under 35 U.S.C. § 103 are in no way an admission or suggestion that each reference does not independently anticipate the Asserted Claims under § 102. Any of the references disclosed herein may be combined with other references disclosed herein and/or with the knowledge of one of ordinary skill in the art during the relevant time period to render obvious, and therefore invalid, the Asserted Claims. These combinations are not intended to be exhaustive, as there are many possible combinations of the

references listed herein and it is not practical, particularly at this early stage prior to further factual investigation and claim construction proceedings, to identify and list all potentially relevant combinations. In particular, the Asserted Claims are rendered obvious under 35 U.S.C. § 103 in view of at least, and without limitation, the following:

III. MISC. ORDER ¶ 3-3(A)(3) – CLAIM CHARTS

Invalidity claim charts identifying disclosures in the references identified in Section II *supra* as to the Asserted Claims of the Asserted Patents are provided in attached Exhibit A ('038 Patent), Exhibit B ('653 Patent), and Exhibit C ('679 Patent).

Defendant has identified relevant portions and/or features of the prior art. However, the identified prior art may contain additional descriptions of or alternative support for the claim limitations. Defendant may rely on uncited portions or features of the identified prior art, other documents, and expert testimony, to provide context or to aid in understanding the identified prior art and the state of the art. Citations to a particular figure in a reference include the caption and description of the figure and any text relating to the figure. Similarly, citations to particular text referring to a figure include the figure and caption as well.

Throughout the invalidity claim chart Exhibits A–C, Defendant provides examples of where references disclose subject matter recited in preambles of the Asserted Claims, regardless whether the preambles limit the claims. Defendant reserves the right to argue that the preambles are or are not limitations. Further, where an entry in a claim chart corresponding to a given limitation refers back to the discussion of another claim, the entry incorporates all evidence cited for the other claim.

IV. MISC. ORDER ¶ 3-3(A)(4) – § 112 GROUNDS

As stated above, Defendant incorporates by reference all § 112-based invalidity contentions disclosed to Escort or any of its predecessors-in-interest, whether past or future.

Specifically, for example, Defendant contends that the Asserted Claims of the Asserted Patents are invalid under pre-AIA 35 U.S.C. § 112, ¶ 1 for failing to enable or describe the claimed systems and methods and/or pre-AIA 35 U.S.C. § 112, ¶ 2 as indefinite. S*ee, e.g., Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S. Ct. 2120, 2124 (2014). Where claim language is identified in connection with a pre-AIA 35 U.S.C. § 112 deficiency, Defendant reserves the right to focus on particular claim language within or surrounding the identified claim language to show the pre-AIA 35 U.S.C. § 112 deficiency.

Defendant contends that none of the Asserted Claims are entitled to claim priority to any previous application because they are not sufficiently described in or enabled by those applications. Defendant reserves the right to contest any priority dates and further reserve the right to allege additional invalidity grounds as appropriate. For example, many of the charted references qualify as prior art under § 102(e) under Escort's theory that the Asserted Claims of the '038 and '653 Patents are both entitled to a priority date of April 14, 1999. To the extent any of the Asserted Claims of the '038 and '653 Patents are entitled only to a later priority date (and is not invalid on some other ground) and a charted reference would qualify as prior art under § 102(b) based on that later date, Defendant reserves the right to contend invalidity based on that ground.

These contentions are subject to revision and amendment pursuant to Federal Rule of Civil Procedure 26(e) and the Orders of record in this matter to the extent appropriate, for example, in light of further investigation and discovery regarding the defenses, the Court's construction of the claims at issue, or review and analysis of expert witnesses. Defendant offers these contentions in response to Escort's infringement contentions and without prejudice to any position it may ultimately take as to any claim construction issues. To the extent these contentions reflect constructions of claim limitations consistent with or implicit in Escort's infringement contentions,

no inference is intended nor should any be drawn that Defendant agrees with any claim construction implied by Escort's infringement contentions, and Defendant expressly reserves the right to contest such claim constructions.

A. Enablement and Written Description Under Pre-AIA 35 U.S.C. § 112, ¶ 1

As Defendant best understands Escort's infringement contentions at this time, the Asserted Claims of the Asserted Patents are invalid because they fail to meet the "enablement" and "written description" requirements of pre-AIA 35 U.S.C. § 112, ¶ 1. The specifications of the Asserted Patents do not enable or describe the claimed systems and methods.

For example, the specification of the '038 Patent does not enable or describe the full scope of "generating an alert if the at least one characteristic is not similar to a predetermined characteristic," "operable to disable an alert to the incoming radar signal based at least in part upon the position of the radar detector," "operable to disable the alert based at least in part upon the velocity of the radar detector," "operable to disable the alert based at least in part upon the frequency of the incoming radar signal," and/or "operable to enable the alert based at least in part upon the frequency of the incoming radar signal."

Furthermore, the specification of the '653 Patent does not enable or describe the full scope of "data based at least in part upon," "muting an audible alert based upon data received from the button," "storing data in the non-volatile memory based upon data received from the button," "storing the second position in the non-volatile memory based at least in part upon data received from the button," "storing the second position and the frequency of the incoming radar signal in the non-volatile memory based upon data received from the button," "storing the second position and data related to the frequency of the incoming radar signal in the non-volatile memory based upon data received from the button," "storing data in the non-volatile memory based upon data received from the mute button," "storing the second position in the non-volatile memory based

upon data received from the mute button," "storing the second position and the frequency of the incoming radar signal in the non-volatile memory based upon data received from the mute button," "storing the second position and data related to the frequency of the incoming radar signal in the non-volatile memory based upon data received from the mute button," "performing an act that is unrelated to muting an alert based upon data received from the mute button," "storing the second position in the nonvolatile memory based upon first data received from the button," "performing an act that is unrelated to storing a position in the non-volatile memory based upon second data received from the button," "stores data in the non-volatile memory based upon data received from the button," "stores the second position and the frequency of the incoming radar signal in the non-volatile memory based upon data received from the button," "stores data in the non-volatile memory based upon data received from the mute button," "stores the second position in the non-volatile memory based upon data received from the mute button," "stores at least two items in the non-volatile memory based upon data received from the mute button," "performs an act that is unrelated to muting an alert based upon data received from the mute button," "stores data related to the second position in the non-volatile memory based upon first data received from the button," and/or "performing an act that is unrelated to storing a position in the non-volatile memory based upon second data received from the button."

Further still, the specification of the '679 Patent does not enable or describe the full scope of "a warning section responding to the receiver section and providing a warning if a received signal correlates to a law enforcement signal," "configurable in response to digital signals received via said digital interface connector," "receiving signals indicative of vehicle motion from a position determining circuit," "a warning section responding to a signal received by the receiver section greater than a threshold strength," "providing a warning if a received signal correlates to a

law enforcement signal," and/or "determining the threshold strength in relation to vehicle speed data and input from a user of the detector."

B. Indefiniteness Under Pre-AIA 35 U.S.C. § 112, ¶ 2

As Defendant best understands Escort's infringement contentions at this time, the Asserted Claims of the Asserted Patents are invalid because they fail to meet the "definiteness" requirement of pre-AIA 35 U.S.C. § 112, ¶ 2. Specifically, the language of the Asserted Claims fails to provide reasonable certainty as to the claims' scope, and the claims are therefore invalid under § 112, ¶ 2. *See Nautilus*, 134 S. Ct. at 2124 (holding that claims are indefinite when the specification and prosecution history "fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention").

Claims 42, 49, and 50 of the '038 Patent and the Asserted Claims of the '653 Patent are invalid under § 112, ¶ 2 for failure to particularly point out and distinctly claim performing various actions "based upon" or "based at least in part upon" certain data. The claims states that these various actions should be performed, but the specification fails to explain the manner or extent to which the performance of those actions should be based upon the cited data. Accordingly, the language of Claims 42, 49, and 50 of the '038 Patent and the Asserted Claims of the '653 Patent fails to provide reasonable certainty as to the claims' scope, and the claims are therefore invalid under § 112, ¶ 2. *See Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S. Ct. 2120, 2124 (2014) (holding that claims are indefinite when the specification and prosecution history "fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention"); *Interval Licensing LLC v. AOL, Inc.*, 766 F.3d 1364, 1370 (Fed Cir. 2014), *cert. denied*, 136 S. Ct. 59 (2015) ("Although absolute or mathematical precision is not required, it is not enough . . . to identify *some standard* for measuring the scope of the phrase.") (emphasis in original).

Claims	Term
’038 Patent, Claim 42	“generating an alert **based at least in part upon**”
’038 Patent, Claim 45[4]	“operable to disable an alert to the incoming radar signal **based at least in part upon**”
’038 Patent, Claims 49 and 50	“operable to [dis/en]able the alert **based at least in part upon**”
’653 Patent, Claims 22 and 38	“receiving [the] data **based at least in part upon**”
’653 Patent, Claims 25 and 41	“mut[ing/es] an audible alert **based upon** data received from the button”
’653 Patent, Claims 26, 30, 42, and 44	“stor[ing/es] data in the non-volatile memory **based upon** data received from the [mute] button”
’653 Patent, Claims 27, 31, and 45	“stor[ing/es] the second position in the non-volatile memory **based [at least in part] upon** data received from the [mute] button”
’653 Patent, Claims 28, 32, and 43	“stor[ing/es] the second position and the frequency of the incoming radar signal in the non-volatile memory **based upon** data received from the [mute] button”
’653 Patent, Claims 29 and 33	“storing the second position and data related to the frequency of the incoming radar signal in the non-volatile memory **based upon** data received from the [mute] button”
’653 Patent, Claims 34 and 47	“perform[s/ing] an act that is unrelated to muting an alert **based upon** data received from the mute button”
’653 Patent, Claim 46	“stores at least two items in the non-volatile memory **based upon** data received from the mute button”

At least the following claim terms/phrases are also indefinite:

- “predetermined distance” (’038 Patent, Claims 19, 23–25)
- “similar to” (’038 Patent, Claim 7)
- “predetermined frequency range” (’038 Patent, Claims 23 and 24)

[4] Claim 45 of the ’038 Patent was found invalid as anticipated in a prior litigation. *See Fleming v. Escort Inc.*, Case No. 1:09-cv-105 (D. Idaho), Defendant includes indefiniteness arguments pursuant to § 112, ¶ 2 regarding Claim 45 because Claims 49 and 50 (which Escort is asserting) depend from Claim 45.

- "predetermined radar frequency" ('038 Patent, Claims 23 and 24)
- "operable to enable" ('038 Patent, Claim 49)
- "operable to disable" ('038 Patent, Claim 50)
- "police signal" ('679 Patent, Claims 28 and 40)
- "law enforcement signal" ('679 Patent, Claim 1)
- "being responsive to" ('679 Patent, Claim 1)
- "adapted to" ('679 Patent, Claims 28 and 40)
- "indicative of police activity" ('679 Patent, Claims 28 and 40)
- "signals generated in the context of law enforcement activity" ('679 Patent, Claim 1)
- "until at least said signals indicative of vehicle motion indicate vehicle motion over a distance" ('679 Patent, Claim 1)

V. ADDITIONAL INVALIDITY GROUNDS

The Asserted (and unasserted) Claims of the '038 Patent are invalid because they fail to satisfy 35 U.S.C. § 101's patentable subject matter requirement. The '038 Patent (i) is directed to an abstract idea of filtering information and (ii) fails to disclose an inventive concept that transforms the otherwise abstract idea into patent eligible subject matter. *Alice Corp. v. CLS Bank Int'l,* 134 S. Ct. 2347, 2555 (2014); *Bascom Glob. Internet Servs., Inc. v. AT&T Mobility LLC*, 827 F.3d 1341, 1348 (Fed. Cir. 2016). None of the claimed elements of the '038 Patent, considered both individually and as an ordered combination, transform the nature of the claims into a patent eligible application. Defendant incorporates by reference the § 101 arguments set forth in its Rule 12(b)(6) Motion to Dismiss. (*See* Dkt. No. 15.)

The Asserted (and unasserted) Claims of the '653 Patent are invalid because they fail to satisfy 35 U.S.C. § 101's patentable subject matter requirement. The '653 Patent (i) is directed to an abstract idea of filtering information and (ii) fails to disclose an inventive concept that transforms the otherwise abstract idea into patent eligible subject matter. *Alice*, 134 S. Ct. at 2555; *Bascom*, 827 F.3d at 1348. None of the claimed elements of the '653 Patent, considered both individually and as an ordered combination, transform the nature of the claims into a patent eligible application.

The Asserted (and unasserted) Claims of the ’679 Patent are invalid because they fail to satisfy 35 U.S.C. § 101’s patentable subject matter requirement. The ’679 Patent (i) is directed to an abstract idea of filtering information and (ii) fails to disclose an inventive concept that transforms the otherwise abstract idea into patent eligible subject matter. *Alice*, 134 S. Ct. at 2555; *Bascom*, 827 F.3d at 1348. None of the claimed elements of the ’679 Patent, considered both individually and as an ordered combination, transform the nature of the claims into a patent eligible application.

VI. ACCOMPANYING DOCUMENT PRODUCTION

Pursuant to Misc. Order 62 ¶ 3-4(b), Defendant has produced or is producing prior art references and corroborating evidence concerning prior art systems that do not appear in the file histories of the Asserted Patents. These prior art references and corroborating evidence are cited in and support the accompanying invalidity charts. Defendant’s search for prior art references, additional documentation, and/or corroborating evidence is ongoing. Accordingly, Defendant reserves the right to continue to supplement its production as it obtains additional prior art references, documentation, and/or corroborating evidence concerning invalidity during the course of discovery.

Dated: August 3, 2018

By: */s/ David B. Conrad*

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ATTORNEYS FOR DEFENDANT
UNIDEN AMERICA CORPORATION

CERTIFICATE OF SERVICE

The undersigned hereby certifies that on August 3, 2018, all counsel of record who are deemed to have consented to electronic service are being served with a copy of this document via electronic mail.

/s/ David B. Conrad
David B. Conrad

EXHIBIT 4

US007576679B1

(12) **United States Patent**
Orr et al.

(10) **Patent No.: US 7,576,679 B1**
(45) **Date of Patent: Aug. 18, 2009**

(54) **RADAR DETECTOR WITH POSITION AND VELOCITY SENSITIVE FUNCTIONS**

(75) Inventors: **Steven K. Orr**, Cincinnati, OH (US); **Robert Gregory Blair**, Cincinnati, OH (US); **John Kuhn**, Sharonville, OH (US); **Timothy A. Coomer**, West Chester, OH (US)

(73) Assignee: **Escort Inc.**, West Chester, OH (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/620,443**

(22) Filed: **Jan. 5, 2007**

(51) **Int. Cl.**
G01S 7/40 (2006.01)
H04B 17/00 (2006.01)
G01S 13/00 (2006.01)

(52) **U.S. Cl.** **342/20**; 342/13; 342/89; 342/104; 342/105; 342/115; 342/175; 342/195; 342/357.01; 342/357.06; 701/200; 701/207; 701/213

(58) **Field of Classification Search** .... 342/13, 342/20, 89–93, 165, 173–175, 189–197, 342/357.01–357.17, 103, 104–116; 455/226.1; 340/425.5, 438, 439, 441, 557, 902, 903, 340/936, 988; 700/90; 701/97, 110, 119, 701/213–216, 200, 207; 324/175; 250/214 R, 250/214 B

See application file for complete search history.

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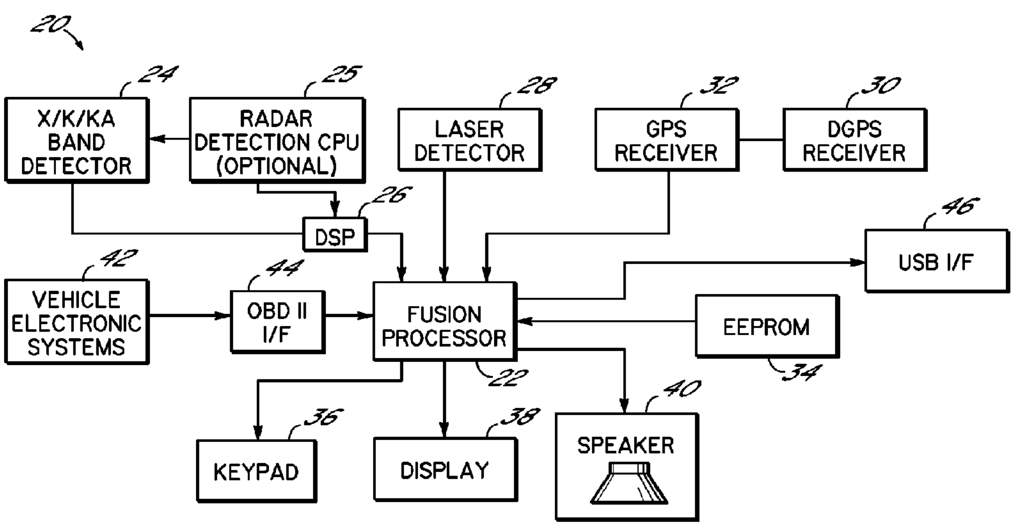
Primary Examiner—Bernarr E Gregory
(74) *Attorney, Agent, or Firm*—Wood, Herron & Evans LLP

(57) **ABSTRACT**

A GPS enabled radar detector dynamically handles radar sources based upon previously stored geographically referenced information on such sources and data from the GPS receiver. The detector includes technology for determining the location of the detector, and comparing this location to the locations of known stationary sources, to improve the handling of such detections. The detector may ignore detections received in an area known to contain a stationary source, or may only ignore specific frequencies or may handle frequencies differently based upon historic trends of spurious police radar signals at each frequency. Notification of the driver will take on a variety of forms depending on the stored information, current operating modes, and vehicle speed.

43 Claims, 11 Drawing Sheets



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RE39,038	E	3/2006	Fleming, III	
RE40,653	E	3/2009	Fleming, III	

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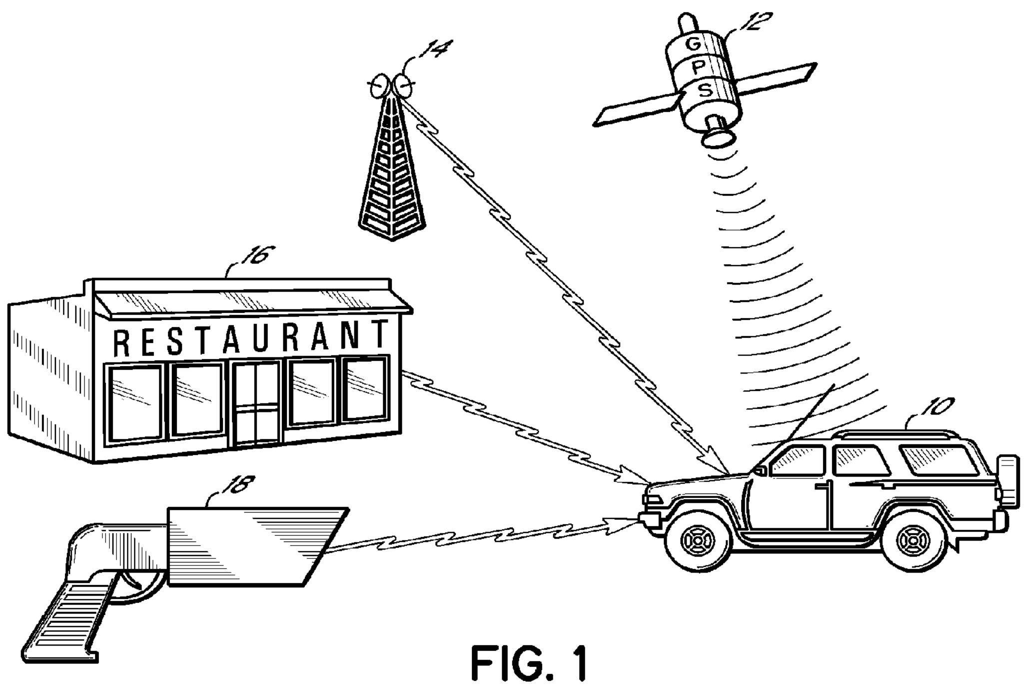

14
12
G
P
S
16
RESTAURANT
10
18

FIG. 1

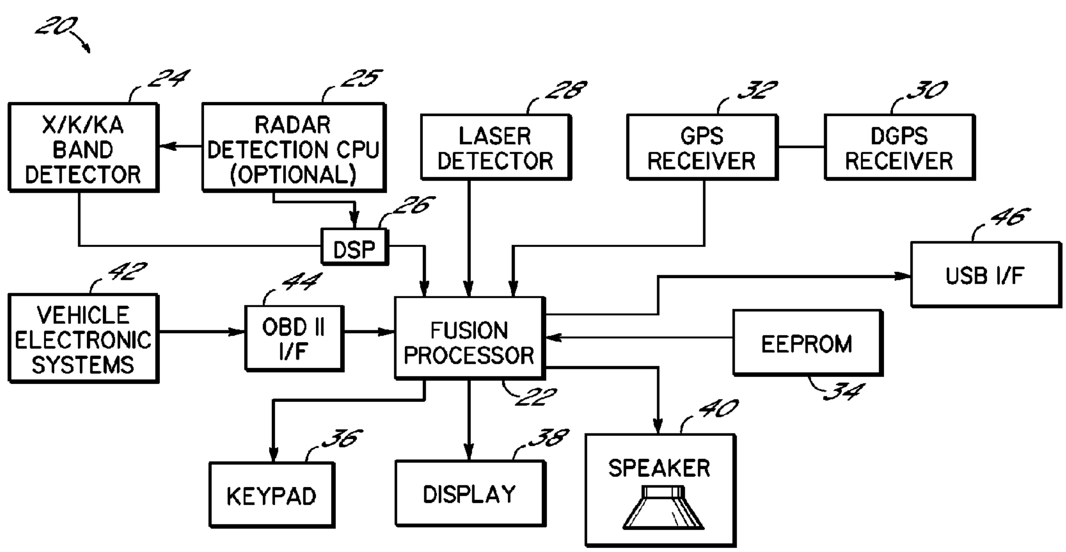

20
24
X/K/KA BAND DETECTOR
25
RADAR DETECTION CPU (OPTIONAL)
28
LASER DETECTOR
32
GPS RECEIVER
30
DGPS RECEIVER
26
DSP
46
USB I/F
42
VEHICLE ELECTRONIC SYSTEMS
44
OBD II I/F
FUSION PROCESSOR
22
EEPROM
34
40
36
KEYPAD
38
DISPLAY
SPEAKER

FIG. 2

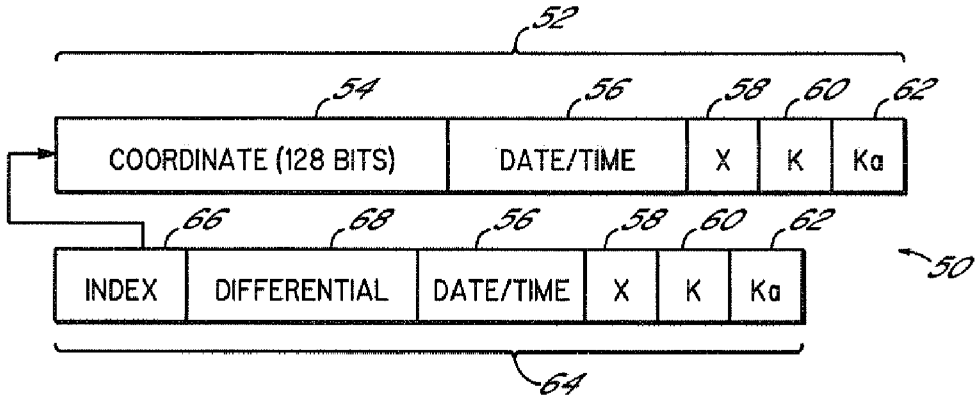


FIG. 3

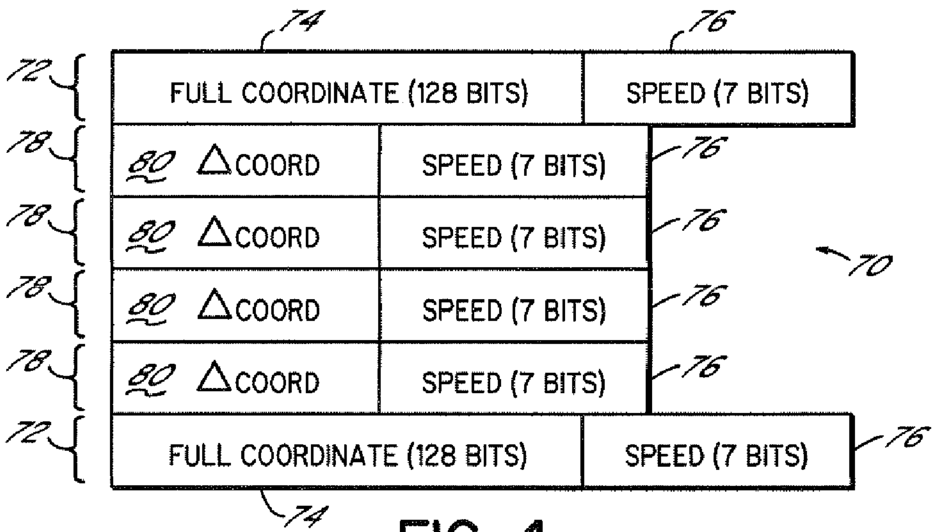


FIG. 4

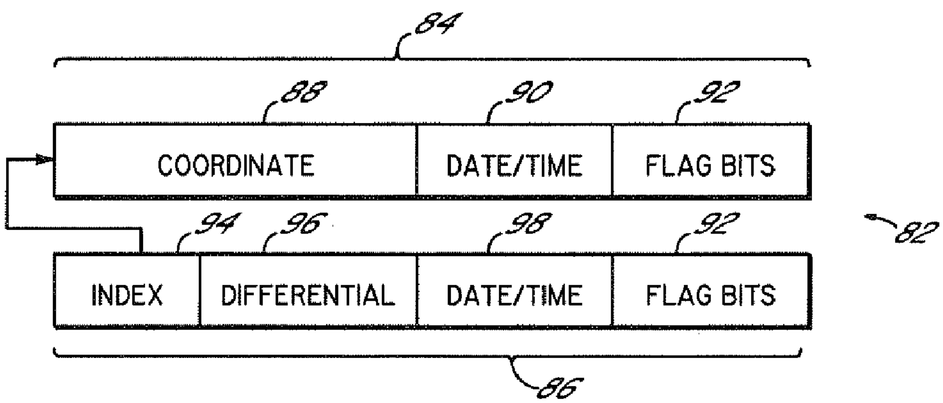


FIG. 5

			Spectrum					
Longitude 3 bytes	Latitude 3 bytes	Heading 1 byte	X 10 bits	K 20 bits	Mark 1 bit	Data 1 bit	Date 2 bytes	Checksum 1 byte

Fig. 6

FIG. 6A

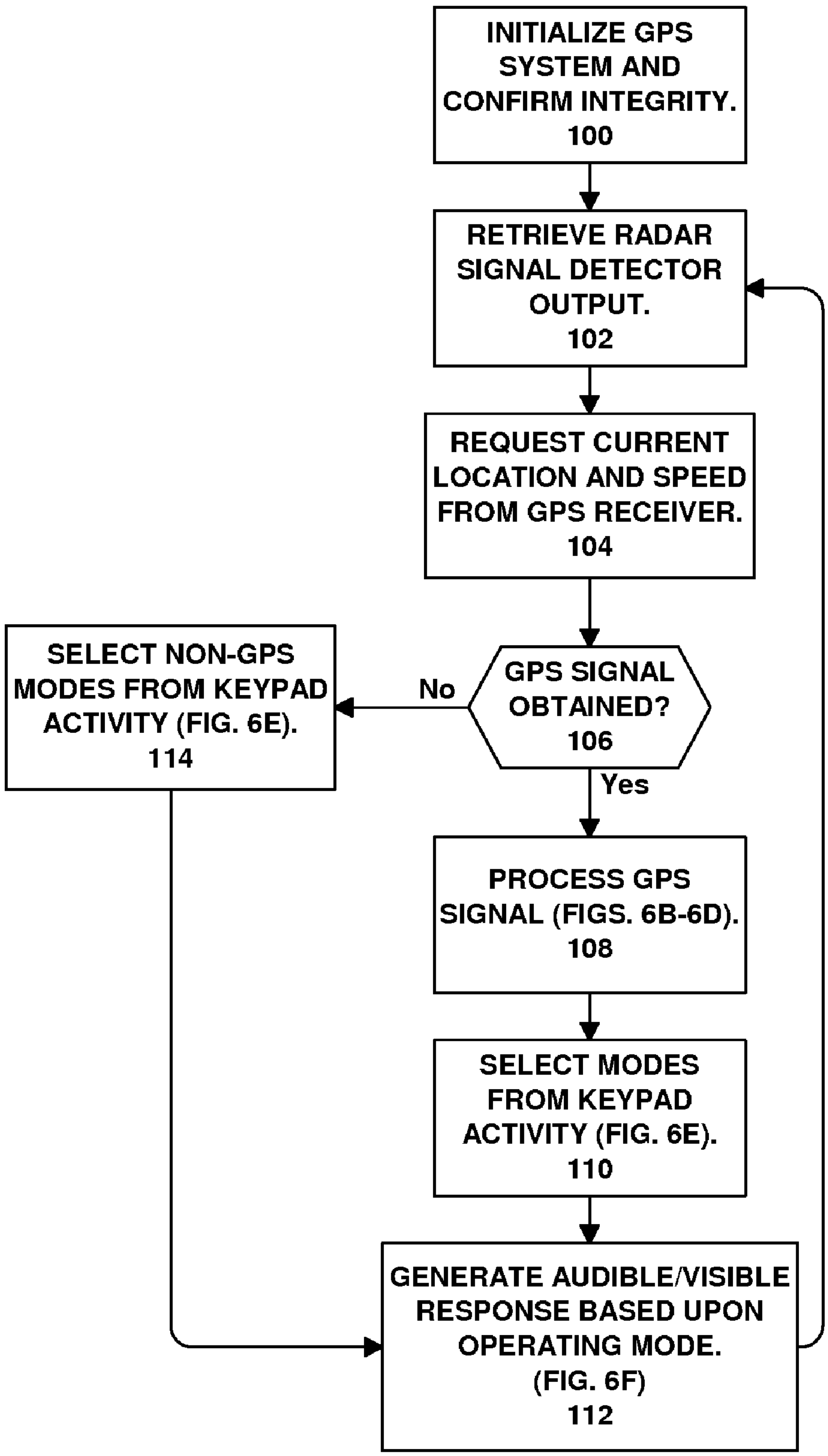

INITIALIZE GPS SYSTEM AND CONFIRM INTEGRITY. 100
RETRIEVE RADAR SIGNAL DETECTOR OUTPUT. 102
REQUEST CURRENT LOCATION AND SPEED FROM GPS RECEIVER. 104
GPS SIGNAL OBTAINED? 106
No
Yes
SELECT NON-GPS MODES FROM KEYPAD ACTIVITY (FIG. 6E). 114
PROCESS GPS SIGNAL (FIGS. 6B-6D). 108
SELECT MODES FROM KEYPAD ACTIVITY (FIG. 6E). 110
GENERATE AUDIBLE/VISIBLE RESPONSE BASED UPON OPERATING MODE. (FIG. 6F) 112

FIG. 6B

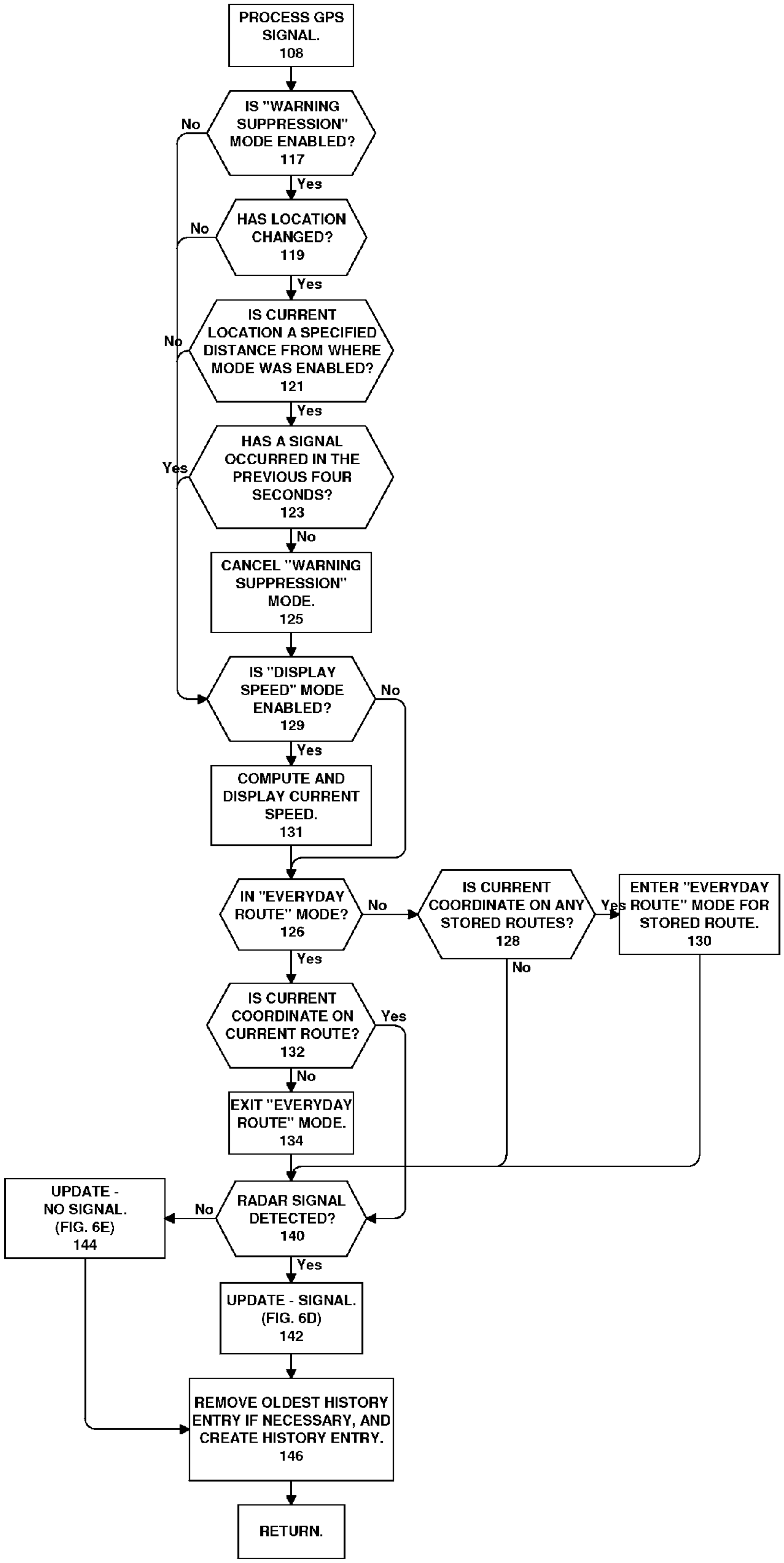

PROCESS GPS SIGNAL. 108
IS "WARNING SUPPRESSION" MODE ENABLED? 117
No
Yes
HAS LOCATION CHANGED? 119
No
Yes
IS CURRENT LOCATION A SPECIFIED DISTANCE FROM WHERE MODE WAS ENABLED? 121
No
Yes
HAS A SIGNAL OCCURRED IN THE PREVIOUS FOUR SECONDS? 123
Yes
No
CANCEL "WARNING SUPPRESSION" MODE. 125
IS "DISPLAY SPEED" MODE ENABLED? 129
No
Yes
COMPUTE AND DISPLAY CURRENT SPEED. 131
IN "EVERYDAY ROUTE" MODE? 126
No
IS CURRENT COORDINATE ON ANY STORED ROUTES? 128
Yes
ENTER "EVERYDAY ROUTE" MODE FOR STORED ROUTE. 130
No
Yes
IS CURRENT COORDINATE ON CURRENT ROUTE? 132
Yes
No
EXIT "EVERYDAY ROUTE" MODE. 134
UPDATE - NO SIGNAL. (FIG. 6E) 144
No
RADAR SIGNAL DETECTED? 140
Yes
UPDATE - SIGNAL. (FIG. 6D) 142
REMOVE OLDEST HISTORY ENTRY IF NECESSARY, AND CREATE HISTORY ENTRY. 146
RETURN.

FIG. 6C

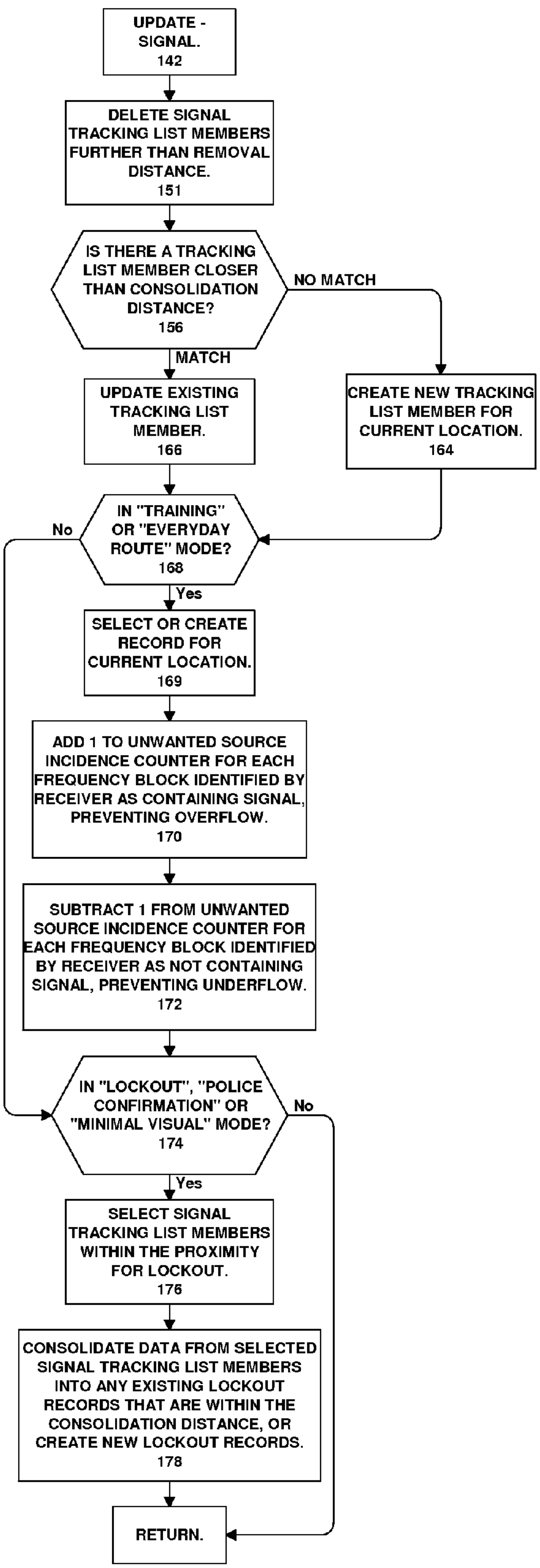

UPDATE - SIGNAL. 142
DELETE SIGNAL TRACKING LIST MEMBERS FURTHER THAN REMOVAL DISTANCE. 151
IS THERE A TRACKING LIST MEMBER CLOSER THAN CONSOLIDATION DISTANCE? 156
NO MATCH
MATCH
UPDATE EXISTING TRACKING LIST MEMBER. 166
CREATE NEW TRACKING LIST MEMBER FOR CURRENT LOCATION. 164
IN "TRAINING" OR "EVERYDAY ROUTE" MODE? 168
No
Yes
SELECT OR CREATE RECORD FOR CURRENT LOCATION. 169
ADD 1 TO UNWANTED SOURCE INCIDENCE COUNTER FOR EACH FREQUENCY BLOCK IDENTIFIED BY RECEIVER AS CONTAINING SIGNAL, PREVENTING OVERFLOW. 170
SUBTRACT 1 FROM UNWANTED SOURCE INCIDENCE COUNTER FOR EACH FREQUENCY BLOCK IDENTIFIED BY RECEIVER AS NOT CONTAINING SIGNAL, PREVENTING UNDERFLOW. 172
IN "LOCKOUT", "POLICE CONFIRMATION" OR "MINIMAL VISUAL" MODE? 174
No
Yes
SELECT SIGNAL TRACKING LIST MEMBERS WITHIN THE PROXIMITY FOR LOCKOUT. 176
CONSOLIDATE DATA FROM SELECTED SIGNAL TRACKING LIST MEMBERS INTO ANY EXISTING LOCKOUT RECORDS THAT ARE WITHIN THE CONSOLIDATION DISTANCE, OR CREATE NEW LOCKOUT RECORDS. 178
RETURN.

FIG. 6D

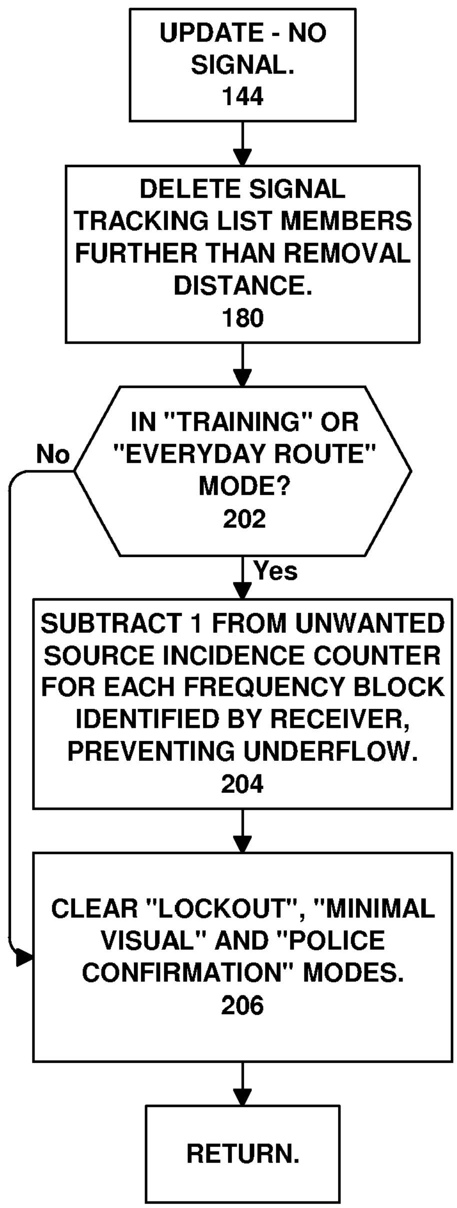

UPDATE - NO SIGNAL. 144
DELETE SIGNAL TRACKING LIST MEMBERS FURTHER THAN REMOVAL DISTANCE. 180
IN "TRAINING" OR "EVERYDAY ROUTE" MODE? 202
No
Yes
SUBTRACT 1 FROM UNWANTED SOURCE INCIDENCE COUNTER FOR EACH FREQUENCY BLOCK IDENTIFIED BY RECEIVER, PREVENTING UNDERFLOW. 204
CLEAR "LOCKOUT", "MINIMAL VISUAL" AND "POLICE CONFIRMATION" MODES. 206
RETURN.

FIG. 6E

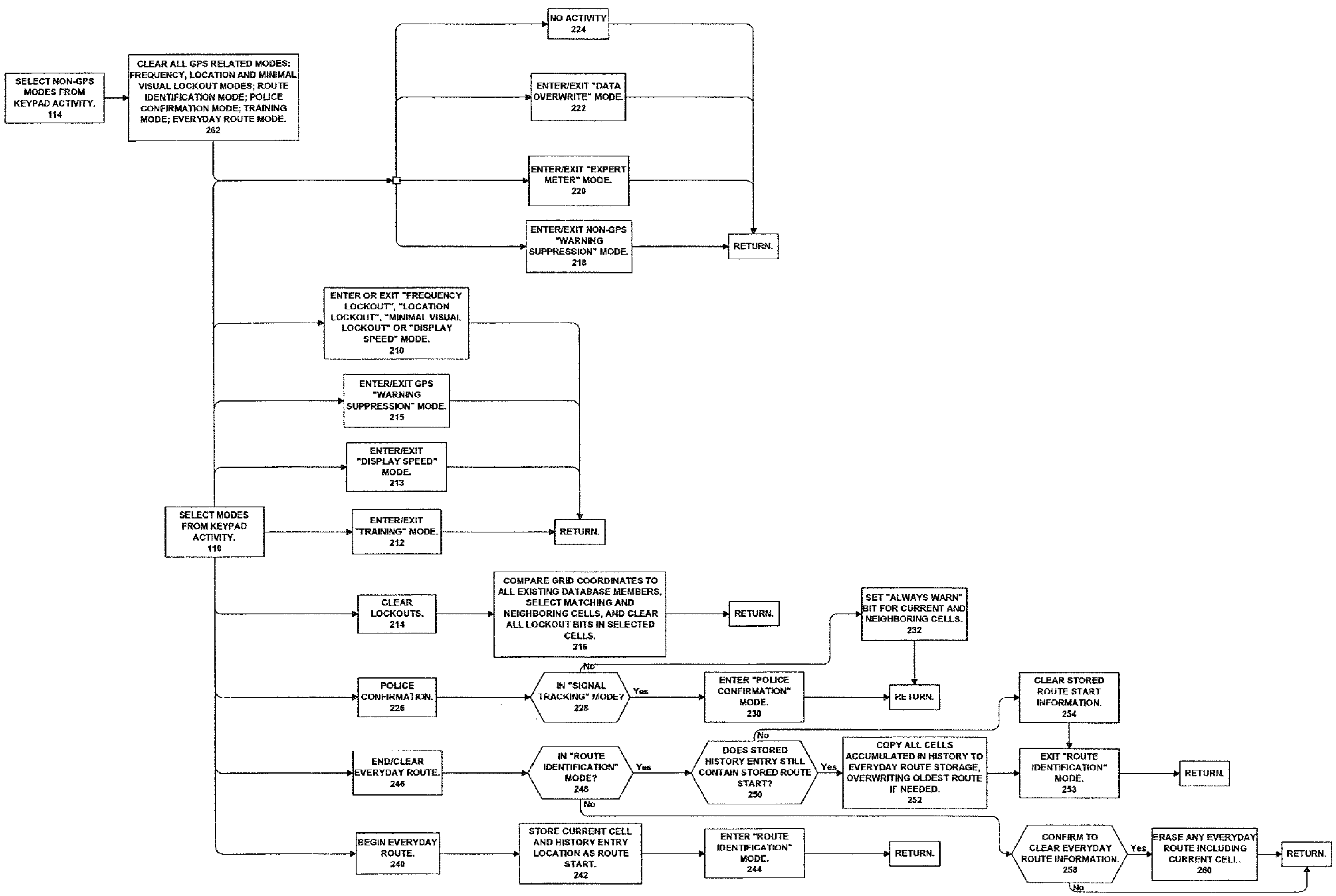

SELECT NON-GPS MODES FROM KEYPAD ACTIVITY. 114
CLEAR ALL GPS RELATED MODES: FREQUENCY, LOCATION AND MINIMAL VISUAL LOCKOUT MODES; ROUTE IDENTIFICATION MODE; POLICE CONFIRMATION MODE; TRAINING MODE; EVERYDAY ROUTE MODE. 262
NO ACTIVITY 224
ENTER/EXIT "DATA OVERWRITE" MODE. 222
ENTER/EXIT "EXPERT METER" MODE. 220
ENTER/EXIT NON-GPS "WARNING SUPPRESSION" MODE. 218
RETURN.
ENTER OR EXIT "FREQUENCY LOCKOUT", "LOCATION LOCKOUT", "MINIMAL VISUAL LOCKOUT" OR "DISPLAY SPEED" MODE. 210
ENTER/EXIT GPS "WARNING SUPPRESSION" MODE. 215
ENTER/EXIT "DISPLAY SPEED" MODE. 213
SELECT MODES FROM KEYPAD ACTIVITY. 110
ENTER/EXIT "TRAINING" MODE. 212
RETURN.
CLEAR LOCKOUTS. 214
COMPARE GRID COORDINATES TO ALL EXISTING DATABASE MEMBERS, SELECT MATCHING AND NEIGHBORING CELLS, AND CLEAR ALL LOCKOUT BITS IN SELECTED CELLS. 216
RETURN.
SET "ALWAYS WARN" BIT FOR CURRENT AND NEIGHBORING CELLS. 232
POLICE CONFIRMATION. 226
No
IN "SIGNAL TRACKING" MODE? 228
Yes
ENTER "POLICE CONFIRMATION" MODE. 230
RETURN.
CLEAR STORED ROUTE START INFORMATION. 254
END/CLEAR EVERYDAY ROUTE. 246
IN "ROUTE IDENTIFICATION" MODE? 248
Yes
No
DOES STORED HISTORY ENTRY STILL CONTAIN STORED ROUTE START? 250
Yes
No
COPY ALL CELLS ACCUMULATED IN HISTORY TO EVERYDAY ROUTE STORAGE, OVERWRITING OLDEST ROUTE IF NEEDED. 252
EXIT "ROUTE IDENTIFICATION" MODE. 253
RETURN.
BEGIN EVERYDAY ROUTE. 240
STORE CURRENT CELL AND HISTORY ENTRY LOCATION AS ROUTE START. 242
ENTER "ROUTE IDENTIFICATION" MODE. 244
RETURN.
CONFIRM TO CLEAR EVERYDAY ROUTE INFORMATION. 258
Yes
No
ERASE ANY EVERYDAY ROUTE INCLUDING CURRENT CELL. 260
RETURN.

FIG. 6F

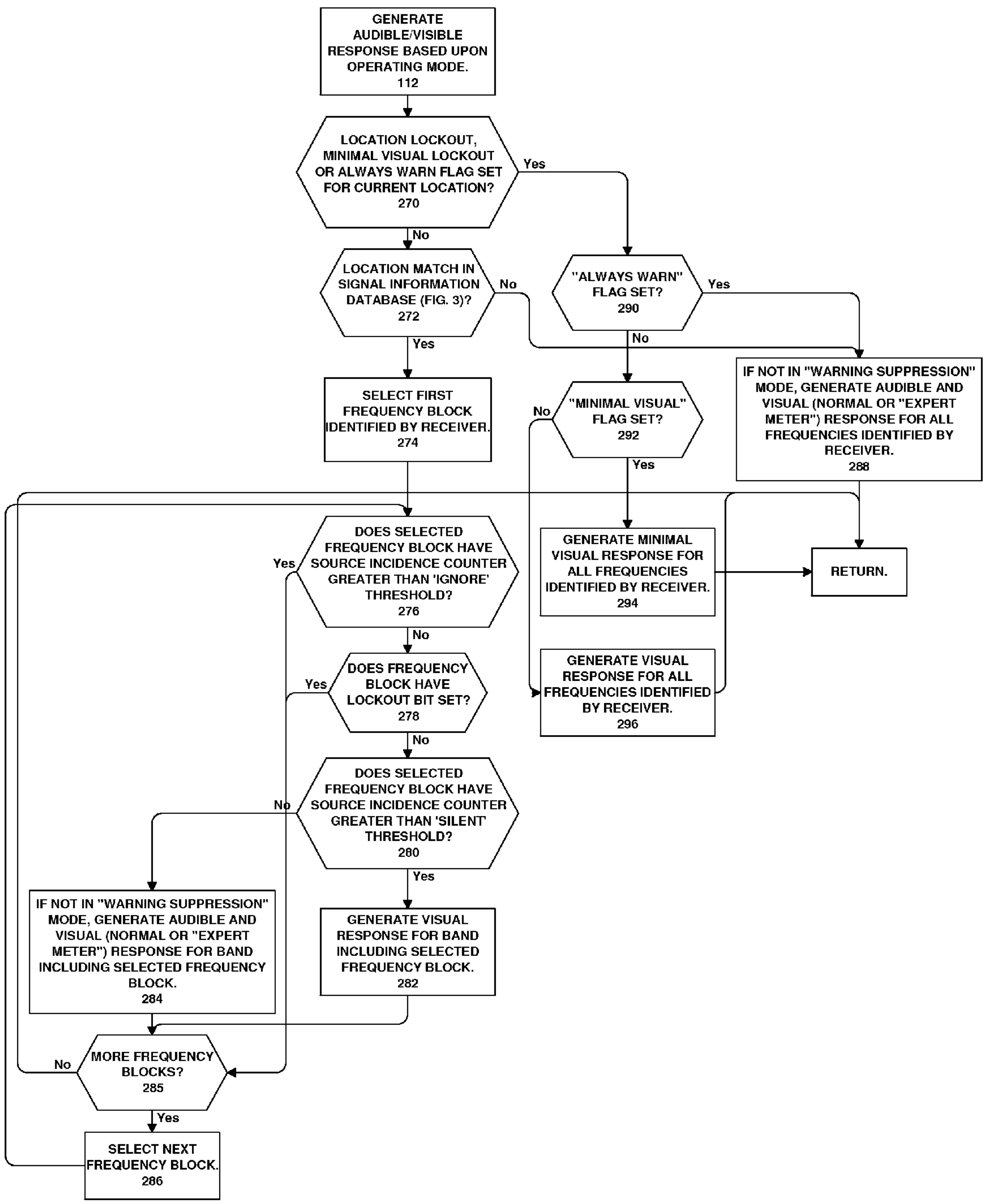
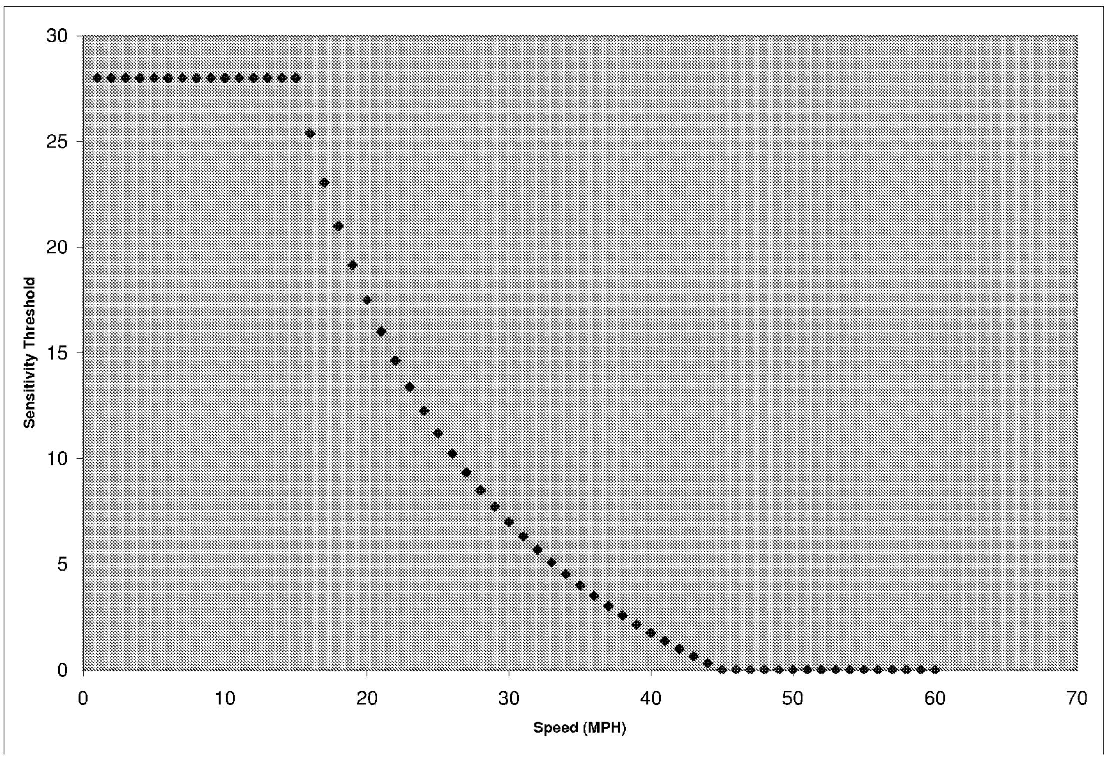

GENERATE AUDIBLE/VISIBLE RESPONSE BASED UPON OPERATING MODE. 112
LOCATION LOCKOUT, MINIMAL VISUAL LOCKOUT OR ALWAYS WARN FLAG SET FOR CURRENT LOCATION? 270
Yes
No
LOCATION MATCH IN SIGNAL INFORMATION DATABASE (FIG. 3)? 272
No
Yes
"ALWAYS WARN" FLAG SET? 290
Yes
No
IF NOT IN "WARNING SUPPRESSION" MODE, GENERATE AUDIBLE AND VISUAL (NORMAL OR "EXPERT METER") RESPONSE FOR ALL FREQUENCIES IDENTIFIED BY RECEIVER. 288
SELECT FIRST FREQUENCY BLOCK IDENTIFIED BY RECEIVER. 274
"MINIMAL VISUAL" FLAG SET? 292
No
Yes
DOES SELECTED FREQUENCY BLOCK HAVE SOURCE INCIDENCE COUNTER GREATER THAN 'IGNORE' THRESHOLD? 276
Yes
No
GENERATE MINIMAL VISUAL RESPONSE FOR ALL FREQUENCIES IDENTIFIED BY RECEIVER. 294
RETURN.
DOES FREQUENCY BLOCK HAVE LOCKOUT BIT SET? 278
Yes
No
GENERATE VISUAL RESPONSE FOR ALL FREQUENCIES IDENTIFIED BY RECEIVER. 296
DOES SELECTED FREQUENCY BLOCK HAVE SOURCE INCIDENCE COUNTER GREATER THAN 'SILENT' THRESHOLD? 280
No
Yes
IF NOT IN "WARNING SUPPRESSION" MODE, GENERATE AUDIBLE AND VISUAL (NORMAL OR "EXPERT METER") RESPONSE FOR BAND INCLUDING SELECTED FREQUENCY BLOCK. 284
GENERATE VISUAL RESPONSE FOR BAND INCLUDING SELECTED FREQUENCY BLOCK. 282
MORE FREQUENCY BLOCKS? 285
No
Yes
SELECT NEXT FREQUENCY BLOCK. 286

Fig. 7A

	GPS "Slow Speed Cancellation"	Signal Filter	City Gain
HWY			
AUTO	X	X	
City	X		X

FIG. 7B


30
25
20
15
10
5
0
Sensitivity Threshold
0
10
20
30
40
50
60
70
Speed (MPH)

RADAR DETECTOR WITH POSITION AND VELOCITY SENSITIVE FUNCTIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is related to U.S. Ser. No. 10/396,881, filed Mar. 25, 2004, which is a United States divisional application of U.S. Ser. No. 09/889,656, filed Jul. 19, 2001 (with the declaration under Section 371(c)(4) filed Mar. 15, 2002), now U.S. Pat. No. 6,670,905, which is a U.S. National Phase of PCT/US00/16410 filed Jun. 14, 2000, which is a continuation-in-part of both U.S. Provisional Patent Application Ser. No. 60/139,097, filed Jun. 14, 1999, and U.S. Provisional Patent Application Ser. No. 60/145,394, filed Jul. 23, 1999, all of which are hereby incorporated herein in their entirety.

FIELD OF THE INVENTION

The present invention relates to radar detectors.

BACKGROUND OF THE INVENTION

Radar detectors warn drivers of the use of police radar, and the potential for traffic citations if the driver exceeds the speed limit. The FCC has allocated several regions of the electromagnetic spectrum for police radar use. The bands used by police radar are generally known as the X, K and Ka bands. Each relates to a different part of the spectrum. The X and K bands are relatively narrow frequency ranges, whereas the Ka band is a relatively wide range of frequencies. By the early 1990's, police radar evolved to the point that it could operate almost anywhere in the 1600-megahertz wide Ka band. During that time radar detectors kept pace with models that included descriptive names like "Ultra Wide" and "Super Wide." More recently, police have begun to use laser (optical) systems for detecting speed. This technology was termed LIDAR for "Light Detection and Ranging."

Radar detectors typically comprise a microwave receiver and detection circuitry that is typically realized with a microprocessor or digital signal processor (DSP). Microwave receivers are generally capable of detecting microwave components in the X, K, and very broad Ka band. In various solutions, either a microprocessor or DSP is used to make decisions about the signal content from the microwave receiver. Systems including a digital signal processor have been shown to provide superior performance over solutions based on conventional microprocessors due to the DSP=s ability to find and distinguish signals that are buried in noise. Various methods of applying DSP=s were disclosed in U.S. Pat. Nos. 4,954,828, 5,079,553, 5,049,885, and 5,134,406, each of which is hereby incorporated by reference herein.

Police use of laser has also been countered with laser detectors, such as described in U.S. Pat. Nos. 5,206,500, 5,347,120 and 5,365,055, each of which is incorporated herein by reference. Products are now available that combined laser detection into a single product with a microwave receiver, to provide comprehensive protection.

The DSP or microprocessor in a modern radar detector is programmable. Accordingly, they can be instructed to manage all of the user interface features such as input switches, lights, sounds, as well as generate control and timing signals for the microwave receiver and/or laser detector. Early in the evolution of the radar detector, consumers sought products that offered a better way to manage the audible volume and duration of warning signals. Good examples of these solutions are found in U.S. Pat. Nos. 4,631,542, 5,164,729, 5,250,

951, and 5,300,932, each of which is hereby incorporated by reference, which provide methods for conditioning the response generated by the radar detector.

Methods for conditioning detector response are gaining importance, because there is an increasing number of signals present in the X, K, and Ka bands from products that are completely unrelated to police radar. These products share the same regions of the spectrum and are also licensed by the FCC. The growing number of such signals is rapidly undermining the credibility of radar detector performance. Radar detectors cannot tell the difference between emissions from many of these devices and true police radar systems. As a result, radar detectors are increasingly generating false alarms, effectively "crying wolf", reducing the significance of warnings from radar detectors.

One of the earliest and most prevalent unrelated Microwave sources is the automatic door system used in many commercial buildings such as supermarkets, malls, restaurants and shopping centers. The majority of these operate in the X-Band and produce signals virtually indistinguishable from conventional X-Band Police Radar. Other than the fact that door opening systems are vertically polarized, vs circular polarization for police radar, there is no distinction between the two that could be analyzed and used by a receiver design.

Until recently, virtually all of the door opening systems was designed to operate in the X-Band. As a result, radar detectors generally announced X-Band alerts far more often than K-Band. As these X-Band >polluters= grew in numbers, ultimately 99% of X-Band alerts were from irrelevant sources. X-Band alerts became meaningless. The only benefit that these sources offered the user was some assurance that the detector was actually capable of detecting radar. It also gave the user some intuition into the product=s detection range. To minimize the annoyance to users, most radar detector manufacturers added a filter-like behavior that was biased against X-Band sources. Many also added "Band priority" that was biased against X and in favor of bands that were less likely to contain irrelevant sources such as K, Ka, and Laser. If signals in both X and K Bands were detected, band prioritization would announce K, since it was more likely be a threat to the driver. In the last few years, K-Band door opening systems have also grown in number. This has reduced the significance of the K-Band warning and further undercut the overall benefit to the user of a radar detector.

Another unrelated microwave signal is generated by traffic management systems such as the ARTIMIS manufactured by TRW, used in Cincinnati, Ohio. ARTIMIS Stands for "Advanced Regional Traffic Interactive Management and Information System", and reports traffic flow information back to a central control center. Traffic congestion and other factors are analyzed by the control center. Control center employees use this information to formulate routing suggestions and other emergency information, which they transmit to a large distribution of overhead and roadside signs. In order to collect information on vehicle traffic, a roadside ARTIMIS station transmits an X-Band signal toward cars as they drive by. The ARTIMIS source, unlike the X-Band door opener systems, is distinguishable from police radar as it is not transmitted at a single fixed frequency. As a result, it is possible to differentiate police radar signals from sources such as ARTIMIS, and ignore ARTIMIS sources in newer detectors. Older detectors, however, do not incorporate this feature and could be obsolete in areas where ARTIMIS is in use.

Unrelated Microwave signals are also transmitted by a system called the RASHID VRSS. Rashid is an acronym for Radar Safety Brake Collision Warning System. This electronic device warns heavy trucks and ambulances of hazards

in their path. A small number of these RASHID VRSS units have been deployed. They are categorized as a member of the >non-stationary= set of unrelated sources. As in the ARTIMIS example, detection of RASHID can be prevented.

Perhaps the biggest source of non-stationary unrelated source is from other radar detectors. These are sometimes referred to as "polluting radar detectors", and present a serious threat to some detector products. An early example of this occurred in the mid 1980's when radar detectors using superhomodyne circuitry became popular. Such detectors leak energy in the X-Band and K-bands and appeared as police radar to other detectors. A solution to this problem is described in U.S. Pat. No. 4,581,769, which is hereby incorporated by reference in its entirety. A similar problem occurred in the early 1990's when the Ka band was widened. An unexpected result was that the wider Ka band then also detected harmonics of signals generated by local oscillators within many existing radar detectors. U.S. Pat. No. 5,305,007, which is hereby incorporated by reference in its entirety, describes a method for ignoring these polluting detectors.

At this time, there are very few signal sources that can cause false laser detections in comparison to the substantial list of false microwave signals just described. However there are certain types of equipment that can cause the amplifiers and detection circuitry used in a laser detector to generate a "false" detect. In particular, certain locations near airports have been demonstrated to cause such problems for various laser detector products. As a result, selected airport environments are examples of stationary signals that produce false laser detections.

As can be appreciated from the foregoing example, as sources of unrelated signals continue to propagate, radar detectors must continually increase in sophistication to filter unrelated sources and accurately identify police radar. Each of these changes and enhancements has the potential effect of obsoleting existing detectors that do not include appropriate countermeasures. Furthermore, some sources, particularly stationary door opener sources, at this time cannot be filtered economically, and thus threaten the usefulness of even the most sophisticated modern radar detector.

During the 1980's, the functionality of radar detectors expanded into other classes of driver notification. A system was developed that required a special transmitter be placed on emergency vehicles, trains, and other driving hazards. The term >emergency radar= was coined, and a variety of products were introduced that could detect these transmitters. One such solution was disclosed in U.S. Pat. No. 5,559,508, which is hereby incorporated by reference herein in its entirety. Another system was later introduced offering a larger class of >hazard categories= called the SWS system. Both emergency radar and SWS involve the transmission of microwave signals in the >K= band. Such signals are considered to be a part of the group of signal types that are intended to be detected by radar detectors.

A drawback of these warning systems is that stationary transmitters of these signals send the same message to drivers constantly, and become a nuisance during daily commute. This is beneficial to >new= drivers receiving the message for the first time. However these messages become an annoyance to drivers who follow the same path to work everyday.

Thus, radar detector manufacturers are continually confronted with new problems to solve, due to the variety of different types of unrelated sources and their sheer numbers. The rate at which new or upgraded radar detector models are introduced continues to increase as manufacturers try to evolve their products to manage the growing number of unrelated sources. Meanwhile, the market for radar detectors is

shrinking because consumers are no longer interested in buying products that so quickly become obsolete.

SUMMARY OF THE INVENTION

The present invention overcomes these difficulties by providing a method of operating a radar detector that aids in the management of unrelated sources, and permitting the detector to dynamically improve its handling of unrelated sources. As noted above, many non-stationary sources can be identified and ignored using existing technology. However, many stationary sources cannot, as yet be effectively filtered economically with existing technology. Accordingly, the invention provides a radar detector that includes technology for determining the location of the detector, and comparing this location to the locations of known stationary sources, to improve the handling of such detections.

In one embodiment, a radar detector may ignore detections received in an area known to contain a stationary source. In the specific embodiment described below, substantially more sophisticated processing is performed to determine whether and what actions to take in response to a detection.

The Global Positioning Satellite System (GPS) offers an electronic method for establishing current physical coordinates very accurately. In the detailed embodiment described below, a radar detector utilizes a GPS system to determine its current position. The detector also maintain a list of the coordinates of the known stationary source "offenders" in non-volatile memory. Each time a microwave or laser source is detected, it will compare its current coordinates to this list. Notification of the driver will take on a variety of forms depending on the setup configuration.

By adding GPS conditioning capabilities to a radar detector, the combination becomes a new product category that is capable of rejecting signals from any given location no matter what the nature of the microwave/laser signals might be from that location. This will have a dramatic effect on the usable life of the product and subsequent value to its owner.

The above and other objects and advantages of the present invention shall be made apparent from the accompanying drawings and the description thereof.

BRIEF DESCRIPTION OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with a general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the invention.

FIG. **1** is an illustration of a vehicle receiving radar signals from police radar and from a number of unrelated sources, and further receiving global positioning signals from a global positioning satellite;

FIG. **2** is an electrical block diagram of a radar detection circuit in accordance with principles of the present invention;

FIG. **3** is a illustration of a database structure used by the radar detection circuit of FIG. **2**, for storing information radar signals received or receivable from unrelated sources at a number of locations, as identified by cell coordinates;

FIG. **4** is an illustration of a database structure used for storing historic information on the locations of a vehicle carrying the radar detection circuit of FIG. **2**, as identified by cell coordinates;

FIG. **5** is an illustration of a database structure used for storing flags identifying various conditions at a number of locations, as identified by cell coordinates;

FIG. **6** is an illustration of an alternate database structure for storing locations and flags relating to those locations;

FIG. **6**A is a flow chart of the operations of the CPU of the radar detector of FIG. **2**, carrying out principles of the present invention;

FIG. **6**B is a flow chart of operations of the CPU of FIG. **2** in processing GPS information when GPS signals are being received;

FIG. **6**C is a flow chart of operations of the CPU of FIG. **2** in updating stored information when a radar signal is being received;

FIG. **6**D is a flow chart of operations of the CPU of FIG. **2** in updating stored information when a radar signal is not being received;

FIG. **6**E is a flow chart of operations of the CPU of FIG. **2** in responding to keypad activity to change operative modes of the GPS enabled radar detector; and

FIG. **6**F is a flow chart of operations of the CPU of FIG. **2** in generating audible and visible responses based upon operating modes of the radar detector and the presence or absence of radar signals and stored information.

FIG. **7**A illustrates the active functions in the three threshold sensitivity modes (highway, auto, and city). The functions are Slow Speed Cancellation, H&K Band Signal Filter, and City Gain.

FIG. **7**B illustrates the relationship between the threshold and the speed of the vehicle, as used in the Slow Speed Cancellation function.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

To provide background for the present invention, a summary of GPS (Global Positioning System) technology will now be provided. GPS is a mature technology that provides a method for a GPS receiver to determine its relative location and velocity at any time. The (GPS) system is a worldwide constellation of 24 satellites and their ground stations. GPS receivers on earth use >line of sight= information from these satellites as reference points to calculate positions accurate to a matter of meters. Advanced forms of GPS actually enable measurements to within a centimeter. The Global Positioning System consists of three segments: a space segment of 24 orbiting satellites, a control segment that includes a control center and access to overseas command stations, and a user segment, consisting of GPS receivers and associated equipment. Over time GPS receivers have been miniaturized to just a few integrated circuits and have become very economical.

An unfortunate side effect of the GPS system is that it can be used by enemy forces, as GPS signals can be picked up by any receiver including both domestic and foreign. When the United States Department of Defense devised the GPS system they incorporated a feature that prevents high precision measurements unless the receiver is equipped with special military >keys.= This is accomplished with the intentional introduction of "noise" into the satellite's clock data which adds noise (or inaccuracy) into position calculations. The DOD sometimes also sends slightly erroneous orbital data to the satellites, which is transmitted back to receivers on the ground. This intentional degradation is referred to as "Selective Availability" or "SA" error. Military receivers use a decryption key to remove the SA errors. As a result of the SA error, there are two classes of GPS service, "Standard Positioning Service (SPS) and "Precise Positioning System" (PPS). These classes are realized by having GPS satellites transmit two different signals: the Precision or P-code and the Coarse Acquisition or C/A-code. The P-code is designed for authorized military users and provides PPS service. To ensure that unauthorized users do not acquire the P-code, the DOD can engage an encryption segment on the P-code called anti-spoofing (AS). The C/A-code is designed for use by nonmilitary users and provides SPS service. The C/A-code is less accurate and easier to jam than the P-code. It is also easier to acquire, so military receivers first track the C/A-code and then transfer to the P-code. Selective availability is achieved by degrading the accuracy of the C/A-code.

The precision of SPS is stated as providing 100-meter horizontal and 156 meter vertical accuracy A95% of the time.@ PPS is only available for the U.S. and allied military, certain U.S. Government agencies, and selected civil users specifically approved by the U.S. Government. PPS provides 22 meters horizontal and 22.7 meters vertical accuracy 95% of the time.

Other than intentional errors inserted by the DOD, there are a variety of other error sources that vary with terrain and other factors. GPS satellite signals are blocked by most materials. GPS signals will not pass through buildings, metal, mountains, or trees. Leaves and jungle canopy can attenuate GPS signals so that they become unusable. In locations where at least four satellite signals with good geometry cannot be tracked with sufficient accuracy, GPS is unusable.

The "Differential GPS" system was developed in order to compensate for the inaccuracy of GPS readings. A high-performance GPS receiver (known as a reference station or beacon) is placed at a specific location; the information it receives is then compared to the receiver=s location and corrects the SA satellite signal errors. The error data is then formatted into a correction message and transmitted to GPS users on a specific frequency (300 kHz). A true or arbitrary set of coordinates is assigned to the position occupied by a reference GPS receiver. The difference between these and the coordinates received via GPS at the reference is a very close approximation to the SA error at nearby sites. This error is nearly identical to the error calculated by any nearby GPS receiver. The reference site is sometimes referred to as a 'beacon', as it constantly transmits these difference coordinates. A DPGS receiver is designed to receive both the GPS information and the beacon information. It generates a far more accurate estimate of its coordinates by applying the difference information to the GPS coordinates. The drawback to this is that the remote and reference receivers may not be using the same set of satellites in their computations. If this is the case, and the remote receiver incorporates the corrections, it may be accounting for satellite errors that are not included in its own measurement data. These corrections can make the differential solution worse than the uncorrected GPS position. To prevent this error, an improved form of differential GPS involves the derivation of the corrections to the actual measurements made at the reference receiver to each satellite. By receiving all of the corrections independently, the remote receiver can pick and choose which are appropriate to its own observations. This method of DGPS is most widely used. Typically, the DGPS correction signal loses approximately 1 m of accuracy for every 150 km of distance from the reference station.

The availability of Beacons for DGPS systems elevates the very threat that the SA error was intended to reduce. In the presence of such networks, potentially hostile weapons systems using DGPS could be developed relatively rapidly. For this reason and others, the SA error has diminished in military significance. The White House has Directed that the S/A error be "Set to Zero" by the year 2006.

In the United States, the US Coast Guard (USCG) and Army Corps of Engineers (ACE) have constructed a network

of Beacon stations that service the majority of the eastern United States, the entire length of both coastlines, and the Great Lakes. Further plans exist to increase the density of this network to provide dual redundant coverage throughout the continental US by the end of the year 2000 for a variety of applications including intelligent transportation system, infrastructure management, and public safety.

The Canadian Coast Guard (CCG) provides coverage in Canada for the St. Lawrence River, throughout the Great Lakes, and both coastlines. In total, there are over 160 stations operational worldwide with over 140 sites proposed to come online within the next two years. Coverage currently exists in many other regions of the world including Europe, Asia, Australia, Africa, and South America.

The beacons perform the differential calculation and broadcast this information by modulating the data onto a 300 kHz signal transmitted by the established network of Radiobeacons. The advantages of using the Beacon DGPS network include: (1) Free access to differential correction information; (2) Long range signal which penetrates into valleys, and travels around obstacles; (3) High quality differential corrections which are continuously monitored for integrity; and (4) Inexpensive user equipment.

The range of the 300 kHz signal is dependent upon a number of factors which include transmission power and conductivity of the surface over which the transmission is propagating. The Beacons within the global network broadcast at varying power. Typical broadcasting ranges for radiobeacons vary from as little as 35 nautical miles to as much as 300 nautical miles. Signals broadcast by DGPS radiobeacons are integrity monitored by remote stations for quality of beacon transmission, differential corrections, and GPS positional information. In addition, government agencies concerned with public safety have made it their mandate to ensure that beacon DGPS services are available 24 hours a day, 365 days a year. Performance requirements for marine applications dictate that an availability of 99% or greater is required if a particular system is to be used as a sole means of navigation. The US Coast Guard and Army Corps of Engineers Beacon Network, for example, offer this high level of availability free of charge to all civilian users.

There are other navigation systems in place, in addition to GPS, that merit review. LORAN-C is a ground-based radio navigation system. It operates on a frequency band of 90 kHz to 110 kHz (LF). It has an approximate range of hundreds to thousands of miles, and an accuracy of 0.25 nautical miles repeatable to 18-90 meters, with 95% confidence. Loran-C is a pulsed hyperbolic system that provides 0.25 nm predictable accuracy, 18-90 m repeatable accuracy, 95% confidence and 99.7% availability. Loran-C provides coverage for the continental U.S. and its coastal waters, the Great Lakes, and most of Alaska. Many other countries are also involved in the providing of Loran-C (or Loran-like) services, or are in negotiations with their neighbors to expand coverage. These countries include India, Norway, France, Ireland, Germany, Spain, Italy, Russia, China, Japan, the Philippines and others.

Omega is a low frequency band system with accuracy of 2 to 4 nautical miles with 95% confidence level. Developed by the United States, it is operated in conjunction with six other nations. OMEGA is a very low frequency, phase comparison, worldwide radio navigation system

TACAN operates in the U.S. in a frequency band of 960 MHz-1215 MHz (UHF). It has a range of approximately 200 miles at high altitudes. TACAN is primarily used by U.S. and other military aircraft. TACAN radio stations are often co-located with civilian VOR systems allowing military aircraft to operate in civil airspace. The system provides the pilot with relative bearing and distance to the radio beacon.

VOR operates in a frequency band of 108.0 MHz-117.95 MHz (VHF). It has an approximate range of 250 miles, but accuracy as poor as 20 miles. VOR is a beacon-based navigation system operated in the U.S. by the Federal Aviation Administration (FAA) for civil aircraft navigation. When used by itself, the system allows users to determine their azimuth from the VOR station without using any directional equipment. VOR stations are radio beacons that transmit two signals. The first, called the reference signal, is transmitted with constant phase all around the transmitter. The second signal is phase shifted from the first depending on the compass direction of the user from the station. A simple, inexpensive receiver in the aircraft is used to determine the received phase difference of the two signals, and from that information the direction of the aircraft from the transmitter. By using two VOR stations, a specific location may be determined.

Of all the navigation systems mentioned, GPS offers better service, more accuracy, and more serviceable regions than any other approach. There are various classes of GPS service that improve accuracy at higher costs. These include the following categories: (1) Low-cost, single receiver SPS projects (100 meter accuracy); (2) Medium-cost, differential SPS code Positioning (1-10 meter accuracy); (3) High-cost, single receiver PPS projects (20 meter accuracy); (4) High-cost, differential carrier phase surveys (1 mm to 1 cm accuracy); and (5) High-cost, Real-Time-Kinematic (1 cm) with real time accuracy indications.

Referring now to FIG. **1**, a vehicle **10** is illustrated in operation on a roadway, under exposure to radio frequency signals from a variety of sources. These include the GPS satellite system, LORAN or OMEGA radio towers, non-police sources of interference such as restaurant **16**, and police radar signals from a radar gun **18**. In accordance with principles of the present invention, vehicle **10** is equipped with a radar detector able to identify the present coordinates and/or velocity of the vehicle, e.g. using an associated GPS receiver or alternatively a receiver of land-based signals such as LORAN. The radar detector is able to use this information to enhance its decision-making abilities.

Referring now to FIG. **2**, the radar detector **20** in accordance with principles of the present invention includes a fusion processor **22** for controlling all functions of the unit. Fusion processor receives information on radar signals from a conventional microwave receiver **24**, coupled to processor **22** via a digital signal processor (DSP) **26**. Microwave receiver **24** and DSP **26** may utilize any of the techniques described above and in the above-referenced patents, for rejecting noise and increasing discrimination between actual and spurious police radar signals. Further, receiver **24** and DSP **26** may be controlled by an optional second CPU **25**, which can enable additional signal evaluation beyond that which is possible using a DSP.

Processor **22** is further connected to a laser detector **28** for detecting police LIDAR signals. Processor **22** is further connected to a GPS receiver **32** and a separate differential GPS (DGPS) receiver **30**, such that differential GPS methodologies may be used where beacon signals are available. Since the radar detector application described in this patent is not a candidate for military class service, it is not able to access the more accurate PPS. However it is considered a "civil user" and can use the SPS without restriction.

Processor **22** executes a stored program, found in an electrically erasable programmable read only memory (EEPROM) **34**, flash memory, or masked read only memory (ROM). The processor is programmed to manage and report

detected signals in various ways depending on its stored program. This programming includes functions for "detector response conditioning," as elaborated below, e.g., with reference to FIGS. **6**A through **6**D.

The radar detector further incorporates a user input keypad or switches **36**. Operational commands are conveyed by the user to processor **22** via the keypad. Processor **22** is further connected to a display **38**, which may comprise one or more light emitting diodes for indicating various status conditions, or in a more feature-rich device, may include an alphanumeric or graphical display for providing detailed information to a user. A speaker **40** is also provided to enable processor **22** to deliver audible feedback to a user under various alert conditions, as is elaborated below.

Processor **22** may further include an interface **44**, such as an OBD II compliant interface, for connection to vehicle electronic systems **42** that are built into the vehicle **10**. Modern vehicles are being equipped with standardized information systems using the so-called OBD II standard interface. This standard interface is described in an article entitled OBD II Diagnostics, by Larry Carley, from Import Car, January 1997, which is hereby incorporated herein by reference. Processor **22**, using the OBD II standard interface **44**, can obtain vehicle speed and other vehicle status information directly from the vehicle, and then may use this information appropriately as described in more detail below.

Processor **22** is further coupled to a Universal Serial Bus (USB) interface **46** (which may be of the series "mini-B" variety) that provides a means for uploading and downloading information to and from processor **22**. It should be noted that there are three types of USB connection, Series "A", "B", and "mini-B". The series "mini-B" receptacle has the dimensions 6.9 mm by 3.1 mm, whereas series "A" has the dimensions 12.5 mm by 5.12 mm. The standard USB is of the series "A" variety. In one embodiment the present invention contemplates the use of the series "mini-B" receptacle. The "mini-B" would utilize less space on the detector than the standard series "A" USB. USB interface **46** may be used to automate the assimilation of coordinate information into data structures in EEPROM **34**, as described below with reference to FIGS. **3** through **6**. USB interface **46** may also be used to interface the detector to a separate host computer or product application containing a larger storage capacity than available from internal memory. Remote storage devices may include any form of dynamically allocatable storage device (DASD) such as a hard disk drive, removable or fixed magnetic, optical or magneto-optical disk drive, or removable or fixed memory card, or any device including a dynamic directory structure or table of contents included in the storage format to permit dynamic storage allocation. The host computer or other connected device need not be visible to the driver and may be in any convenient location, such as under the vehicle dash. USB interface **46** may also be used for the purposes of firmware upgrade. From time to time updates and bug fixes may become available, e.g. through a manufacturer website. USB interface **46** will enable the user to apply the appropriate firmware upgrade or bug fix, whereas in a prior embodiment the manufacturer would have conducted such an upgrade. USB interface **46** could also be used to add other user waypoints. The Internet provides a convenient means for storing and accessing repositories of information. Web sites may be established and devoted to this task, and provide several convenient types of training information. One could be a training file containing the coordinate information from the online "Speed Trap Registry" at the Internet site www.speedtrap.com. This information would be usable to set "always warn" bits at the locales of known speed traps. A second type of training information would be training files submitted by individuals for use in particular areas, and the third type of information would be aggregate training files created by integrating individually-submitted information into single files organized by region. Aggregate training files would be managed and updated by the web site administrator.

Coordinate information can be stored, e.g., on a hard drive organized with an indexed database structure to facilitate rapid retrieval, and the hard drive may include a special purpose processor to facilitate rapid retrieval of this information.

Where a general purpose host computer is connected via the USB interface, it will likely be based on a higher scale CPU chip and thus be able to efficiently carry out complex coordinate comparison tasks such as are described below, and such tasks may be delegated to the host CPU rather than carried out in fusion processor **22**. The host CPU can also anticipate the need for information about particular coordinates based upon vehicle movements, and respond by retrieving records within proximity of the current location for ready delivery to fusion processor **22**. The host computer can also provide navigational functions to the driver, potentially using stored signal information and flag bits to provide the user with location-specific information about driving hazards and potential police stakeout locations.

In a related embodiment, a multithreading processor **22** may be programmed to allow rapid continuous processing of the record database using two parallel threads. A slower background process is devoted to identifying records in the database that are nearest to the current position, and placing the nearest records, e.g., 25 such records, into an operating cache of the fusion processor. A higher speed foreground process may then repetitively and rapidly compares these 25 cached records to the current position. The foreground process may thereby provide decision-making upon a received signal within a 50 mS response time, as is required to acceptably condition any signal detected by the radar receiver in accordance with previously stored records. It will be noted that this approach permits records to be randomly allocated within the database in memory, simplifying the management of the flash memory.

Signal information may also be downloaded from various hosts, for example, a connection may be established directly via the USB interface to an Internet site carrying signal information, as is now done in a text form at the Internet site www.speedtrap.com. An indirect Internet connection may also be established via a host computer. Furthermore, connections may be established between two receivers, e.g. a trained receiver having extensive signal information, and a receiver having less extensive information, to transfer signal information between the receivers so that either or both has a more complete set of signal information.

Generally speaking, processor **22** compares the radar detector=s immediate coordinates with a stored list of the coordinates of unwanted stationary sources. If the radar detector receives a microwave/laser signal within a certain distance of one of these pre-designated sources, processor **22** applies additional constraints to the detection criterion before alerting the user. Since stationary radar sources make up the bulk of the unwanted sources, there is a significant benefit resulting from these functions. Further details on these operations are provided below with reference to FIGS. **6**A through **6**D.

Fusion processor **22** is programmed for efficient handling of repetitive tasks. One of the most highly repetitive calculations in the implementation described below, is the measurement of distance. Distance is defined as the square root of the sum of squares of Delta Latitude (Y) and Delta Longitude (x)

between current position and the position looked up in any given record. To speed this calculation, an approximation may be used to reduce the number of computations. Specifically, the magnitude approximation may be defined as one half of the absolute value of the larger Delta plus the absolute value of the smaller Delta.

Since GPS coordinates are on a sphere, the Latitude (Y) values are linear with respect to actual distance, however Longitude (X) values are not. When the magnitude function calculates distance between two points, it compensates for the Longitude error by scaling the Longitude's "Delta X" value by a "LongitudeFactor." Within a given region of the planet, the LongitudeFactor does not change much and is calculated at power-up and then much less frequently thereafter. The LongitudeFactor is chosen so that the high 16 bits of a u16× u16 multiply will contain the scaled Longitude.

FIG. **3** illustrates one embodiment of data structures **50** stored in EEPROM **34** and used for managing information utilized in accordance with principles of the present invention. As seen in FIG. **3**, these data structures include a plurality of main entries **52**, each including a field **54** for a coordinate, a field **56** for identifying the date and time data was collected, and three fields **58**, **60** and **62** providing information on the source.

Field **54** provides the coordinate. As will be elaborated below, coordinates provided by GPS receiver **32** are reduced in resolution to arrive at a "cell" coordinate, which indicates that the current location of the receiver, which can be within a relatively large (e.g., ⅛ or ¼ mile square) block of space on the Earth's surface. This approach reduces the storage requirements for information stored by the radar detector to a manageable level. The sizes of the cells can be variably adjusted based upon the available memory and the desired precision. In the present example, 128 bits are allocated to storing cell coordinates, so the cell coordinates can only have as much precision as can be provided in 128 bits a cell, e.g., by discarding the least significant bits of the coordinates. In other applications, different bit sizes and resolutions could be utilized. It will also be noted that the storage requirements can be reduced by designing the receiver for operation only in a specified part of the Earth, e.g., only in Europe, Japan or North America. By so doing, part of the coordinates for a cell will not need to be stored because they will be the same for all stored cells. In such an embodiment, whenever the coordinates provided by the GPS receiver fall outside of the pre-established region, the receiver will either disable all storage of information (if approved via operational input from the user), or establish a new region of interest and discard all data from previously identified regions. Alternatively, the operator may set the device in either a "precision" (high coordinate resolution) or "wide area" (low coordinate resolution) mode, based upon the driving habits of the driver. In "wide area" mode, the reduced resolution used for each cell coordinate permits a greater number of coordinates to be stored, albeit with reduced precision as to each coordinate. Rural drivers and others that often follow common paths, would be best suited to "precision" mode, whereas urban drivers would be better suited to "wide area" mode. As a further alternative, the detector may automatically select a mode based upon the memory consumption or the time lapse before the memory of the detector becomes full; if the memory fills rapidly, the unit would automatically switch to a "wide area" mode using low precision coordinates, whereas if the memory never fills or fills only slowly, the unit will remain in its "precision" mode.

The date and time information in field **56** is useful when selecting least recently used (oldest) entries in storage for replacement, as is described further below.

Fields **58**, **60** and **62** store source incidence counters, one for each of a plurality of frequency blocks. Field **58** stores counter(s) for block(s) in the X band. Field **60** stores counter(s) for block(s) in the K band. Field **62** stores counter(s) for block(s) in the Ka band. The number of blocks in each band can vary in different embodiments of the present invention, and is a function of the signal frequency content details provided by the detector **24** and DSP **26**. As one example, the X, K and Ka bands are divided into a total of 32 frequency blocks. Each block is provided a 4-bit counter in fields **58**, **60** and **62**. The counters have a minimum value of 0 and a maximum value of 15, and are a measure of the number of times a signal in the associated frequency block has been detected at that location. As will be described below in greater detail, the "source incidence" counters may be used in some embodiments, to aid in identifying geographic locations that appear to have spurious sources of police radar signals, due to repeated detection of such signals without confirmation of police activity.

In the data structures shown in FIG. **3**, to save space, main entries **52** are interleaved with a greater number of differential entries **64**, each of which stores information for a cell. A first field in a differential entry **64** is an index pointer **66** to a main entry **52**, e.g. an index to a storage location at which the main entry is stored. A second field is a differential field **68** that identifies the difference between the coordinate of the differential entry **64** and the coordinate stored in the main entry **52**. The index and differential can be stored in substantially fewer than 128 bits, so that a differential entry **64** is substantially smaller than a main entry, thus saving storage space. Differential entries further include a date and time field **56** and fields **58**, **60** and **62** for storing counters for X, K or Ka frequencies, as described above.

FIG. **4** illustrates one embodiment of data structures **70** used to store vehicle motion history records or trip records in EEPROM **34**. These data structures include main entries **72** which include field **74** storing a 128 bit cell coordinate, followed by a speed field **76** which can be, for example, 7 bits in length. Differential entries **78** associated with each main entry include a differential coordinate field **80** indicating the difference in the cell coordinate from the associated main entry **72**, and a speed field **76** indicating a speed recorded at the cell. Because motion history records or trip records are stored sequentially during motion of the detector, differential entries **78** are stored after and adjacent to the associated main entry **72**. Accordingly, differential entries **78** do not require an index field to associate the differential entry **78** with a main entry **72**, because the association is implied from the location of the differential entry **78** in memory after its associated main entry **72**.

History entries may be used for a number of purposes. For example, in the following description, history entries are accessed as part of defining an "everyday route" taken by the detector at the operator's identification. History entries may also be used for driver monitoring; they may be downloaded to a host PC via USB interface **46**, and evaluated to determine whether the vehicle has taken abrupt turns, show excessive speed, or entered undesired locations, all of which may be useful in monitoring the activity, e.g., of teenage drivers. History entries may also be uploaded to PC to provide evidence of the driving history of the vehicle before and at the time of a police citation for speeding. If a driver has been unfairly cited for speeding, history records from the detector can provide compelling evidence to court that the citation is in error. For the purpose of enabling these uses, history entries stored by fusion processor **22** are encrypted when stored and

cannot be modified by fusion processor **22** or any PC software supplied for viewing those entries.

FIG. **5** illustrates one embodiment of data structures **82** that can be used to store hazard information and other flag bits related to cells. These data structures **82** include main entries **84** which include a full 128 bit cell coordinate in field **88**, followed by a date and time field **90** and flag bits **92** indicating the hazard or condition associated with the identified location. The differential entries **86** include an index field **94** pointing to one of the main entries, a differential coordinate field **96** indicating the difference in the cell coordinate from the associated main entry **84**, a date and time field **98**, and a set of flag bits **92** indicating the hazard or condition associated with the identified location. The flag bits may identify various hazard conditions. For example, in the specific embodiment described below, there is an "always warn" flag bit that indicates that police activity has previously been confirmed at the location, and therefore the user should be warned of all apparent police radar signals at the location. Further, there is a "location lockout" flag that indicates that broadband sources of spurious police radar signals have been experienced at the location, and therefore in the future warnings of police radar signals should be suppressed at the location. Similarly, a "minimal visual lockout" flag indicates that, due to the unwanted distraction of spurious police radar warnings at a location, only a minimal visual warning should be made of police radar signals identified at the location. It should be noted that a visual warning could be in the form of the current vehicle speed, which may more accurately display the vehicle speed than the vehicles on board speedometer. Alternatively, a "display speed" mode could be entered to continuously display the vehicle's speed, as elaborated below. The flag bits further include "frequency lockout" bits, one for each frequency block identified by the radar receiver. These bits identify frequencies at the location in which spurious police radar signals have previously been encountered, so that in the future apparent police radar signals at the same frequencies are ignored. The flag bits may also include additional flags to warn of other conditions, such as that there was construction at the identified location, or that some other cause for traffic slowdowns were seen at the identified location, to aid in vehicle navigation.

The information contained in the databases described above may be assimilated by the detector through operation, as is described below. Alternatively, this information may be pre-installed in the detector, e.g. via an upload from a host PC via the USB port **46**. There would be substantial benefits to pre-training a detector in this way for a particular geographic area. By pre-training the detector, the driver would not have to endure the audible alerts that would naturally occur before it is trained for each source of spurious police radar signals. In a give area, the ideal training profile would not vary much from one detector to the next, since all detectors should reject the same sources in the same areas. As a result, there are few issues that would have to be resolved in order to transfer training information from one radar detector to another.

Training files would have low value if they could not be readily used by other detectors. The transferability of training files from one detector to another will depend on the differences in how real world signals are perceived by their embedded processors. In large part, these differences are a direct result of manufacturing and component variations. During the manufacturing process, a detector goes through a set of calibration steps in order to guarantee that the unit meets specifications for Spectral Band Coverage and Sensitivity. These calibration steps reduce the cost of designing the product since lower cost, poorer tolerance components can be used on the assumption that a final manufacturing calibration procedure will eventually compensate for the lower tolerance. Once calibrated, an acceptable product must also be able to perform over a predefined temperature range.

Component tolerance, manufacturing calibration, and operating temperature are key factors that determine how the spectrum of microwave signals are >viewed= by the embedded Microprocessor or DSP. Radar products convert the spectral band such as X-Band into an array of values that are proportional to the signal energy in consecutive slots or bins of the spectrum. In order for the product to be >in tolerance= these slot positions must be adjusted so they precisely cover the full range of X, K, and the Ka bands

The calibration procedure is only concerned with guaranteeing that the slots provide adequate coverage of each band. It is less concerned as to whether any one of these slots falls on a precise physical frequency. Therefore the first frequency block in one detector will not necessarily be perceived at the same frequency as the first slot in another detector.

If training data is to be shared between various detectors, it will be necessary for supporting software to compensate for these variations. When new pre-trained data is supplied, the detector will undergo an authentication procedure in order to determine the relationships between the pre-train data and its own receiver configuration. This will be based on comparing the frequencies of newly encountered sources to those of the pre-train data at matching coordinates. By comparing the observed frequencies to those in the training set, a "correction profile" will be constructed, that represents the change between the pre-train data and the output of the local microwave receiver. At the end of the authentication procedure, the entire pre-training file will be incorporated into the active train data. During the authentication procedure, the user will be exposed to unconditioned detector responses. This authentication procedure will be substantially shorter than the training period of a virgin detector. Once authentication is complete, the user will receive a notification indicating that the product is switching from authentication over to normal operation. If the training mode is engaged, the authenticated data will continue to be massaged by new driving encounters, as detailed below.

Referring now to FIG. **6**, an alternate embodiment of a data structure for storing signal information can be explained. In this embodiment, coordinates and flags regarding those coordinates are stored in a simplified record structure, and source incidence counters are not implemented. In this embodiment, coordinate information is organized into 14-byte records, each identical to the others. A 4-megabit flash memory chip may be organized into 18432 of such records, although larger or smaller memory capacity may be provided in other implementations. The records are used both for locking out spurious signal sources, and for marking other points of interest, such as fast food locations, known locations of police activity, or the path of a frequently-used route.

As with the other database implementations described above, new record is created each time the user locks out or marks a location (by the depression of appropriate keys on the keypad)—unless the lockout or mark is performed within proximity to an existing lockout or mark, in which case the existing record is updated.

The structure of each record, as illustrated in FIG. **6**, as follows:

3 bytes: Longitude (proportional to degrees); the GPS receiver output is rounded to a 24-bit value providing resolution of approximately 9 feet/bit.

3 bytes: Latitude (proportional to degrees); the GPS receiver output is rounded to a 24-bit value providing resolution of approximately 9 feet/bit.

1 byte: Heading in degrees/2

4 bytes: Spectrum

2 bytes: Record Date, usable for replacement of data on a FIFO basis

1 byte: Record Checksum

The 4-byte (or 32 bit) "spectrum" field is further broken down as follows:

10 bits X Spectrum

20 bits K Spectrum

1 bit "Mark bit", which indicates that the record designates a marked location rather than a lockout location

1 bit "Data bit", which indicates that record designates data, not a lockout location

If the "Mark bit" is set, the 30-bit field normally used for X & K spectrum is used to identify one of various available mark location types, including, e.g., "Camera", "Speed Trap", and "Other". Owing to the large number of bits available in the Spectrum field, a wide variety of mark types and data structures could also be defined, including for example a mark type that annotates a location along an everyday route, and a mark type that identifies a record as a history records which may, for example, use a portion of the spectrum field to identify measured speeds. In a specific embodiment, arrival at a marked location causes the detector to generate a display and/or audible warning associated with the type of location.

If the "Mark & Data" bits are clear in a record, the record is a lockout record, and any of the 30 bits in the X & K spectrum fields can be set to indicate locked out bands. The 10 bits of X Spectrum map the 100 mhz X band in 10 mhz increments, and the 20 bits of K Spectrum map the 200 mhz K band in 10 mhz increments. To compensate for variation of the source and receiver, a lockout of a given frequency is a realized by setting 3 bits in a given field, the bit corresponding to the frequency at which signal was detected, and its 2 neighbors.

The "Data" bit is used to identify a record that contains information on signal encounters. "Data" records may be used in automatic or adaptive signal rejection implementations such as the collection of source incidence counters in an everyday route or training mode, or other modes that collect detailed signal information.

Referring now to FIG. **6**A, one embodiment of operations of the fusion processor **22** to carry out principles of the present invention can be described in greater detail. Fusion processor **22** performs a main loop of steps during regular operation of GPS enabled radar detection. This main loop of steps is illustrated in FIG. **6**A and is detailed in FIGS. **6**B through **6**F.

When fusion processor **22** is initialized, i.e., when power to the GPS enabled radar detector is turned on, the device is initialized in step **100**. This initialization step includes performing diagnostic checks on the various circuitry illustrated in FIG. **2** to insure its proper operation, as well as initialization of the GPS receiver **32** to insure GPS signals can be received accurately by fusion processor **22**. In addition, various internal variables, such as a variable for identifying a current position, are initialized. The initial values are chosen to insure proper operation; for example, the current position variable is initialized to a value that will cause the first pass through the main loop FIG. **6**A to include processing of a current location in steps **110** and **112** in accordance with FIGS. **6**B-**6**E, as discussed below.

The first step in the main loop performed by fusion processor **22**, is step **102**, in which radar detection circuitry **24** and **26** is accessed to obtain information on police radar signals currently being received by the GPS enabled radar detector. In a subsequent step **104**, fusion processor **22** communicates with GPS receiver **32** to request a current location and a current vehicle speed from the GPS receiver **32**. This information can then be utilized in performing GPS related operations described in the following steps. As noted above, vehicle speed may also be obtained from the vehicle itself via an OBDII interface **44** if the vehicle in which the GPS enabled radar detector is installed has a suitable OBD connector for delivering vehicle speed information. It will be appreciated further that vehicle location information might also be obtained via an OBDII connector from a GPS receiver that may be built into the vehicle within which the GPS enabled radar detector is installed. When the vehicle in which the GPS enabled radar detector is installed has both vehicle speed and vehicle position information available via an OBDII connector, the GPS receiver **32** may not be used at all, or may not even be included in the GPS enabled radar detector, to facilitate cost reduction for the GPS enabled radar detector.

Following steps **102** and **104** in which current police radar and GPS related information is obtained, different actions are taken based upon whether GPS information is available. Specifically, in step **106** it is determined whether a GPS signal has been received. If a GPS signal is available, then all GPS enhanced functions of the radar detector may be performed. If no GPS signal has been received, then the radar detector will revert to processing police radar signals at a manner analogous to conventional non-GPS enabled radar detectors.

Assuming for the moment that a GPS signal is available in step **106**, and therefore a current position for the vehicle is known, then in step **108** a sequence of steps is performed to process the GPS signal, as is further detailed below with reference to FIGS. **6**B, **6**C and **6**D. This processing can include retrieval and/or updating of stored information, such as the police radar information and signal information database illustrated in FIG. **3**, the vehicle history database illustrated in FIG. **4**, the flag database illustrated in FIG. **5** and/or the signal record database illustrated in FIG. **6**.

After processing the GPS signal, in step **110** keypad activity on keypad **36** is detected and processed to alter operating modes of the GPS enabled radar detector, as described below in further detail with reference to FIG. **6**E.

After selecting appropriate modes based upon keypad activity, in step **112**, an appropriate audible or visible response is produced by the GPS enabled radar detector based upon it current operating mode and the presence or absence of radar detector signal received in step **102**. It should be noted that a visible response might also include the "display speed" function. After step **112**, processing returns to step **102** to obtain a new radar detector signal output and a new current location and speed and then perform additional analysis of that data as described above.

As noted above, in some circumstances a GPS signal will not be available during operation of the GPS enabled radar detector. In this case, processing continues from step **106** to step **114** in which any non-GPS related operational modes may be activated based upon the activity at keypad **35**. GPS enabled modes are unavailable so long as no GPS signal has been obtained, so the processing in step **114** eliminates those modes which cannot be activated in the absence of a GPS signal. After step **114**, processing continues to step **112** in which an appropriate audible or visible response is generated based upon the current operating mode and the radar detected signal received in step **102**.

In one embodiment, the processing of GPS signals in step **108** is implemented through a parallel signal tracking process. The signal tracking process generates and updates a cached list of signal tracking data. Each member of this list indicates a location, and signal spectrum information gathered while at that location. The signal tracking process is responsive to the current location and currently received radar signals, and generally operates to add members to a cached signal tracking list, or update existing members, whenever the radar receiver detects signal, and generally operates to delete members from the cached signal tracking list when those members become too distant from the current location. This signal tracking process thereby creates tracked signal information that is available for processing in the event that the user requests a lockout—in such a case all of the members of the signal-tracking list are examined and any member that meets certain criterion is stored in the database as a lockout record.

The signal tracking process described above utilizes two operating constants. These constants are described below, and representative values are identified:

Region Consolidation for Tracked Signals—0.3 miles: when spectral components are identified by the detector, the signal tracking process checks the tracked signal list for members within the region consolidation distance of the current position. If there is a member that is nearby, the spectral components that are currently identified are added to that list member. If the current position is greater than this distance from any member of the tracked signal list, then a new member is added to the tracked signal list, and initialized with the received spectral components.

Removal Distance for Tracked Signals—1.0 miles: Whenever current location is updated, any member of the tracked signal list that is greater than the removal distance from the current location is removed from the tracked signal list.

In the event of a lockout request from the user, selected members of the signal tracking list are processed to create lockout records, using three operating constants. These constants are described below, and representative values are identified:

Proximity For Lockout—0.5 miles: When the user requests a lockout, then those members of the tracked signal list that are within the proximity for lockout distance from the current position, selected for storage into lockout records in the memory.

Lockout Region Consolidation—0.35 miles: When a tracked signal list member is selected for storage into a lockout record, its position compared those of existing lockout records. If there is an existing record within the lockout region consolidation distance, the spectrum stored in the selected member of the signal list is added to the existing record. Otherwise, a new record is created in the memory, and the spectrum of the selected member of the signal list is added to the new record.

Unlock Removal Distance for Locked Regions—0.8 miles: When the user requests to unlock a location, all lock records in memory (regardless of their spectral content) that are within this distance of the current location, are removed from memory.

A final constant utilized in processing received radar signals is the Lockout Region Radius, which may be 0.5 miles: When radar is detected, the current position is compared to lockout records in memory, and if there is a lockout record that is within the lockout region radius of the current position, then a warning is suppressed or modified for all frequency bands that are marked in the record.

It will be noted that it is possible to drive through an array of interfering signals that span multiple 0.35-mile regions. In one implementation of the present invention, once the user requests a lockout, the receiver will remain in a lockout mode, and continue to generate lockout records, as appropriate, so long as any signal is continuously being tracked. Thus, if a lockout is requested in the midst of an array of signals spanning more than 0.35 miles, at each advance of 0.35 miles, a new lockout record will be created in memory and initialized with the spectrum received over the most recent 0.35 mile distance, until no further signal is received.

In various embodiments of the invention, a wide variety of operative modes may be selectable and controllable through the keypad. Possible modes include:

a "warning suppression" mode in which warnings, particularly audible warnings, produced by the radar detector are suppressed so that they are not disturbing to the operator of the vehicle. The "warning suppression" mode may be either GPS based or non-GPS based.

an "expert meter" mode in which detailed information regarding received warning signals are displayed on display **38** of the GPS enabled radar detector, as described in U.S. Pat. No. 5,668,554, which is hereby incorporated by reference herein in its entirety.

a "data overwrite" mode in which the GPS enabled radar detector saves, into the signal information database of FIG. **3**, data regarding any location not previously stored in the database, even when this signal information database is full, by overwriting the oldest data in the signal information database when necessary. When the "data overwrite" mode is disabled, then the signal information database will not be overwritten once it becomes full.

a "frequency lockout" mode, in which police radar frequencies detected by the receiver are taken to be from non-police sources, and appropriate records are stored. The "frequency lockout" mode is engaged by the vehicle operator when non-police radar signals are being received and the operator wishes to suppress future warning signals caused by the same sources at the same geographic locations. As noted below, "frequency lockout" mode can only be engaged while the GPS enabled radar detector is detecting an apparent police radar signal and will be automatically disengaged when this signal is no longer being received.

a "location lockout" mode, in which the flag database of FIG. **5** is updated to suppress all audible warnings of radar signals at the current location of the vehicle. As is the case with the "frequency lockout" mode, the "location lockout" mode will be enabled by a vehicle operator when the vehicle is near to a known source of spurious police radar signals of a broadband character. The "location lockout" mode can only be engaged while the GPS enabled radar detector is detecting an apparent police radar signal, and will be automatically disengaged whenever a police radar signal is no longer being received from the GPS enabled radar detector.

a "minimal visual lockout" mode, in which the flag database of FIG. **5** is updated to suppress most or all visual warnings of radar signals at the current location of the vehicle. The "location lockout" mode will be enabled by a vehicle operator when the vehicle is near to a known source of spurious police radar signals of a broadband character, and at that location does not wish to be disturbed by even a visual radar signal warning. The "location lockout" mode can only be engaged while the GPS enabled radar detector is detecting an apparent police radar signal, and will be automatically disengaged

whenever a police radar signal is no longer being received from the GPS enabled radar detector.

a "display speed" mode, in which the vehicles current speed is continuously displayed

a "police confirmation" mode, in which flags in the flag database of FIG. **5** will be set to insure a warning signal is always delivered for any police radar signal received at the current vehicle location. The "police confirmation" mode will be activated by a vehicle operator upon sighting a police stakeout.

a "training" mode, in which the GPS enabled radar detector will store signal information for all geographic locations that the GPS enabled radar detector reaches or passes during operation. When "training" mode is disabled, the signal incidence counters found in the signal information database of FIG. **3**, will not be modified by the GPS enabled radar detector during its normal operation.

a "route identification" mode in which the route currently traveled by the vehicle is memorized by the GPS enabled radar detector to be subsequently referenced in performing radar detection. Using "route identification" mode, a user may establish one or more everyday routes traveled by the vehicle, and cause the GPS enabled radar detector to continuously update its signal incidence information in the signal information database of FIG. **3** whenever one of these routes are traversed. Routes are identified by an operator by entering the "route identification" mode at the beginning a route, and then exiting the "route identification" at the end of the route.

Referring now to FIG. **6**B, in one particular embodiment, the processing performed on a GPS signal in step **108** of FIG. **6**A can be described in greater detail. In step **117**, the fusion processor determines whether "warning suppression" mode has been enabled. If so, then the fusion processor determines **119** whether the current location is different from the previous location; if not, the "warning suppression" mode is continued. If the current location is different from the previously identified location, the fusion processor determines **121** whether the current location is more than a specified distance from the location where the "warning suppression" mode was enabled, if not, then the "warning suppression" mode is continued. If the current location is more than a specified distance from the location that the "warning suppression" mode was enabled, the fusion processor determines **123** whether a predetermined mute time, e.g., four seconds, has elapsed without the detection of radar; if not then the "warning suppression" mode is continued, otherwise, "warning suppression" mode is cancelled **125**.

After the above-described processing relating to "warning suppression" mode, the fusion processor determines **129** whether the "display speed" mode has been enabled; if so, the current speed is computed and displayed **131**. Thereafter, steps are taken to manage "everyday route" modes of the GPS enabled radar detector, if implemented. As noted above, the user of the GPS enabled radar detector may establish one or more everyday routes traveled by the vehicle and cause the GPS enabled radar detector to, along those routes, continuously update its signal incidence information. Accordingly, if these modes are implemented, when the GPS enabled radar detector detects that it is following one of these everyday routes, then it will automatically enter its everyday route mode, and subsequently perform different processing (as further described below in connection with FIGS. **6**C and **6**D). As seen in FIG. **6**B, (a.) if the detector has been following an everyday route, an evaluation is made whether the GPS enabled radar detector is continuing to follow the previously defined everyday route, or (b.) if the detector has not been following an everyday route, a determination is made whether the GPS enabled radar detector has started following a previously defined everyday route.

In the first step of this process, in step **126** it is determined whether the GPS enabled radar detector is already in its "everyday route" mode. If the radar detector is not currently in its "everyday route" mode, then it is determined whether the radar detector is entering an everyday route; specifically, in step **128**, it is determined whether the current coordinate is on any of the pre-stored everyday routes. If the current coordinate is on one of the everyday routes, then the GPS enabled radar detector will determine that the vehicle carrying the detector is beginning or joining one of these pre-stored routes. In such a case, in step **130** the GPS enabled radar detector will enter its "everyday route" mode for the stored route containing the current coordinate. If the current coordinate is not on any stored route, step **130** is bypassed.

Returning to step **126**, if the GPS enabled radar detector is already in its "everyday route" mode, then it is determined whether the detector is continuing to follow this route. In this case, processing proceeds from step **126** to step **132** to determine whether the everyday route is being followed. Specifically, in step **132** it is determined whether the current coordinate is on the current everyday route. If not, then in step **134** the GPS enabled radar detector exits "everyday route" mode, indicating that the vehicle is no longer on the previously stored everyday route. Otherwise, step **134** is bypassed, and the detector remains in its "everyday route" mode.

Following step **134** or immediately following step **130**, additional steps are performed to determine whether and how to update previously stored signal incidence information in the signal information database of FIG. **3**. Processing also proceeds to step **140** from steps **132** or directly from step **128** based upon conditions described above.

In step **140** it is determined whether a radar signal is being received by the GPS enabled radar detector. If so, then in step **142** the procedure described below with reference to FIG. **6**C is performed to update, as needed, the signal information database. If no radar signal is being currently detected, then in step **144** the process described below with reference to FIG. **6**D is performed to update, as needed, the signal information database. After step **142** or **144**, in step **146** if the detector implements a history database, that database is updated by removing the oldest history entry from that database (if necessary to make room), and creating a new history entry for the current cell. The new history entry will include the cell coordinate or a differential coordinate as discussed above with reference to FIG. **4**, and would also include a vehicle speed as obtained in step **104** from the GPS receiver or alternatively from an OBD II interface to the vehicle. Following step **146**, the processing of the GPS signal is complete.

Referring to FIG. **6**C, updating of the signal information in the presence of a police radar signal can be elaborated. In the first step **151**, any signal tracking list members that are further than the Removal Distance For Tracked Signals are deleted. Next, different actions are taken based upon whether the signal tracking list already contains signal information for the detector's current coordinate. If there is no tracking list member for a coordinate within the Region Consolidation For Tracked Signals distance, then a new tracking list entry is created **164**. If, however, there is already a tracking list member for a nearby location, that member is updated. Thereafter, in step **168** it is determined whether the GPS enabled radar detector is in its "training" or "everyday route" mode. As noted above, in these modes, where implemented, detailed signal information stored in the database is continuously updated each time a location is encountered. Accordingly, if

the detector is in either its "training" or "everyday route" mode, then in step **170** the unwanted source incidence counter for each frequency block identified by the radar receiver **24** as containing signal, is incremented, preventing an overflow. Subsequently, in step **172** the unwanted source incidence counter for each frequency block identified by the radar receiver **24** as not having signal, is decremented, preventing an underflow. This thus updates the source incidence counters for each frequency block for the current location. After this processing, (or immediately after step **168** if the GPS enabled radar detector does not implement or is not using the "training" or "everyday route" mode,) the "lockout" and/or the additional "police confirmation" and "minimal visual" modes discussed above, are processed. Specifically, if in step **174**, one of these modes is engaged, then in step **176** the signal tracking list members that are within the proximity for lockout are selected, and in step **178**, the data from the selected tracking list members is stored in the signal database, along with, as appropriate, an indication of the specific mode involved. Step **178** involves updating any existing lockout records that are within the Lockout Region Consolidation distance, and creating new lockout records where there are no existing lockout records within the consolidation distance. At the conclusion of these operations, updating in step **142** is complete.

Referring now to FIG. **6**D, processing in step **144**, to update various databases when no signal is detected, can be explained. As will be elaborated below, when no police radar signal is being received by the GPS enabled radar detector, this indicates that many of the modes described above for tracking and identifying sources of police radar signal should be terminated.

First, in step **180** any signal tracking list members that are further than the Removal Distance For Tracked Signals are deleted. If no signal is received over a period of time while the detector continues to move, this step will eventually purge the signal tracking list of all members, but only after the detector has moved beyond the removal distance from all locations where signals were received.

After the foregoing, if the detector is implementing "training" and/or "everyday route" modes, in step **202** it is determined whether the detector is in its "training" or "everyday route" mode. If so, then the detector should update the stored signal information for the current location as part of those modes. Specifically, to update signal information, in step **204** all of the unwanted source incidence counters for frequency blocks identified by the receiver are decremented, preventing underflow.

Following step **204**, or immediately following step **200** if there is no matching signal information or step **202** if the detector is not in its "training" or "everyday route" mode, in step **206** any of the "frequency lockout", "location lockout", "minimal visual" and "police confirmation" modes that are implemented by the detector are cleared, because the tracking of a police radar signal has ended, and these modes are therefore no longer relevant to the current location of the vehicle.

Referring now to FIG. **6**E, the processing of keypad activity to enter and exit the various modes described throughout can be explained. As noted with reference to FIG. **6**A, various modes are available only if a GPS signal has been obtained from the GPS receiver. If a GPS signal has been obtained then modes are selected from the keypad beginning at step **110**. If a GPS signal has not been obtained then modes are selected from the keypad beginning at step **114**, and a substantial number of modes are disabled and cannot be selected in this circumstance.

The keypad activity to select and deselect a mode may vary based upon the application and style of the GPS enabled radar detector. The display and keypad **38** and **36** may interact to produce a menu system for selecting particular modes and displaying associated information. Alternatively, individual keys of keypad **36** may be utilized to directly activate certain modes. Furthermore, display **38** may include icons or other indicators to identify currently activated modes.

A first collection of modes that may be activated via the keypad **36**, are the "frequency lockout", "location lockout", and "minimal visual lockout" modes. Through interactions with the keypad in step **210**, the user may initiate or terminate these modes. As described above, when initiated, these modes cause lockout records with tracked signal information to be stored into the signal database.

In step **212** the vehicle operator may enter or exit the "training mode", if such is implemented, which as described above causes the GPS enabled radar detector to collect signal information for all cells that the vehicle traverses.

A third activity that may be undertaken with the keypad, in step **214**, is to request to clear all lockouts for the current vehicle location. This step may be taken where the GPS enabled radar detector has previously been programmed to lockout a frequency or location and subsequently the vehicle operator sights a police source at that location, and wishes to terminate the lockout at that location. When the vehicle operator requests to clear all existing lockouts, in step **216** the coordinates of the vehicle location are compared to all existing records in the signal database, and all matching and/or neighboring locations (as determined based upon the Unlock Removal Distance for Locked Regions) are selected and all lockout records regarding those locations are cleared.

The vehicle operator may also enter or exit a "warning suppression" mode in step **218**, in which a warning for a currently tracked police radar signal is suppressed, i.e., so that the detector does not continue to issue warning signals for the same radar signal received. A warning suppression function has been implemented in prior radar detectors, but prior detectors would discontinue suppression of a warning when a signal had not been received for a predetermined time period, such as 4 seconds. In the case of an intermittently received non-police signal, this could lead to a user having to constantly re-suppress the warning. The present invention, in one aspect, contemplates adding a location component to warning suppression if a GPS signal is present. Only after the detector has moved an appropriate distance from the location where the user activated the "warning suppression" mode, will the detector exit "warning suppression" mode. It would also be useful if the location detection and time delay could be used in combination, to create an even more efficient "warning suppression" mode. In the event that a GPS signal is not present the "warning suppression" mode will be based on time only.

An operator may also enter or exit an "expert meter" mode in step **220**, requesting that enhanced information on police radar signals received and/or GPS related lockout information or signal incidence information be displayed on display **38** of the detector. An operator may also enter a "data override" mode in step **222**, thus requesting that signal information for new locations visited by the vehicle not found in the database be stored, even at the expense of overriding the oldest previously stored data of this kind. It is also possible, as shown in FIG. **6**E, that there may be no keypad activity at the time that operation of the detector passes through step **110**. In this circumstance, step **224**, no further processing is performed.

A further action that a vehicle operator may take is to confirm of a police sighting in step **226**. This step causes the detector to enter "police confirmation" mode, if such a mode is implemented, so that the detector will ensure that police radar signals at the identified stakeout location is handled with particular urgency. If at the time that the operator presses the police confirmation, no apparent police radar signal is currently being tracked, then processing will continue from step **228** to step **232** in which the "always warn" flag bit is set for the current and neighboring cells of the current location of the vehicle. This step ensures that in future times when a police radar signal is detected in these locations, a warning will be delivered to the vehicle operator regardless of other conditions applicable at the time. If a signal is being tracked at the time that the vehicle operator enters a police confirmation, then a slightly different activity is undertaken. Specifically, in this case processing continues from step **228** to step **230** in which the "police confirmation" mode is entered. As noted above with respect to FIG. **6**D, once the receiver is in police confirmation mode, during signal tracking, locations along the tracked path of the vehicle when the police radar signal was detected, will be noted in the signal database.

A further activity that may be undertaken by a vehicle operator is to indicate that the vehicle is at the beginning of an everyday route, in step **240**. This mode, if implemented, causes the GPS enabled radar detector to begin to collect information on the everyday route, for the purpose of ultimately storing a definition of an everyday route to be evaluated in connection with the processing described in connection with FIG. **6**B, step **128**. When the user indicates that the vehicle is at the beginning of an everyday route, in step **242** the current cell coordinate and the current entry in the vehicle history database of FIG. **4** are stored for later reference. Then in step **244** the detector enters a "route identification" mode, used later in establishing that a route has been identified and is being tracked. When the user wishes to complete an everyday route or wishes to clear everyday route processing for the current vehicle location, the user engages an end or clear operation in step **246**. When this step is taken by the user, an initial determination is made in step **248** whether the detector is currently in its "route identification" mode. If so, then the user has identified the end of the everyday route that was previously identified in step **240**. Thus, in step **250** it is determined whether the history entry identified and marked in step **242** continues to store the location of the route start that was stored in step **242**. If so, then all of the cells accumulated in the vehicle history following the history entry identified in step **242**, describe the route taken by the vehicle along the path selected by the user. In this case, all cells accumulated in the history database of FIG. **4** are copied to a special "everyday route" storage area so that all of these cells are available for analysis in connection with the processing of FIG. **6**B, step **128**. After storing the accumulated history entry cells, in step **252**, processing is completed. After step **252**, in step **253** the "route identification" mode is exited.

If in step **250**, it is determined that the vehicle history database is no longer storing the start of the everyday route defined by the user, then the everyday route defined by the user was too lengthy to be processed by the GPS enabled radar detector. In such a situation, in step **254** the stored route start information is cleared and the "route identification" mode is exited.

If in step **248**, the GPS enabled radar detector is not in "route identification" mode at the time that the vehicle operator requests the end of everyday route in step **246**, then the vehicle operator may wish to delete any everyday route that includes or passes through the current cell. Thus, in step **258**, a display is generated to the operator requesting confirmation that any everyday route including the current cell should be cleared. If a confirmation is received in step **258**, then in step **260** all everyday routes including the current cell are erased from the everyday route storage of the GPS enabled radar detector. If the vehicle operator does not confirm erasure of everyday route information, then processing completes without erasing any everyday route information.

In step **114** of FIG. **6**A, non GPS modes of the GPS enabled radar detector may be activated utilizing keypad activity. This step may be taken if no GPS signal is available at some point during operation of the GPS enabled radar detector. In such a circumstance, in step **262** all GPS related modes of the GPS enabled radar detector are cleared. These include the frequency, location and minimal visual lockout modes, the route identification mode, the police confirmation mode, the training mode and the everyday route mode (step **262**). After clearing these modes, non GPS related modes of the GPS enabled radar detector can be initiated. These modes include the "warning suppression" mode (step **218**), the "expert meter" (step **220**), and the "data override" mode (step **222**). Other modes that the operator may attempt to select will be ignored so long as no GPS signal is being received.

Referring now to FIG. **6**F, operations performed in connection with generating audible and visible responses to police radar signals can be explained. In a first step **270**, it is determined whether any of a number of lockout records or flags are applicable to the current location. In this step **270**, for example, the flag database of FIG. **5** or the flags in records in the database shown in FIG. **6** may be evaluated to see if there is an entry for the current location, and if so (to the extent implemented) whether the location lockout, minimal visual lockout or always warn flags in that entry are set. In the absence of flags, or in embodiments where "minimal visual", "always warn" and "location lockout" flags are not implemented, processing of police radar signals at the current location proceeds based upon information in the signal information database, or based upon defaults if there is no previously stored information. Accordingly, if none of the flags identified in step **270** are set, then in step **272** it is determined whether there is a location match in the signal information database, based for example upon the Lockout Region Radius noted above. If there is such a match, the frequencies identified by the radar receiver are compared to the signal information in the entry in the database.

In the first step of this process, the first frequency block identified by the receiver is selected (step **274**). Then, in step **276**, for implementations where frequency blocks are associated with source incidence counters, it is determined whether the selected frequency block in the signal information database has a source incidence counter greater than a predetermined "ignore" threshold. If radar signals have been frequently detected in the selected frequency block, but there has never been a police sighting there, this is strongly indicative of a false source at that location. Accordingly, if the source incidence counter for a frequency block exceeds the "ignore" threshold, then any police radar signals identified in that frequency block are ignored. If, however, source incidence counters are not implemented, or the selected frequency block does not have a source incidence counter greater than this threshold, then in step **278** it is determined whether the frequency block has a lockout flag bit set. If the lockout flag bit is set, then the signal in the frequency block is ignored. Only if the frequency lockout bit for the selected frequency is not set, will processing continue to step **280**. In step **280** it is determined whether the selected frequency block has a source incidence counter greater than a "silent"

threshold. If the source incidence counter exceeds this threshold, then it is likely that there is a false source radar signals at the location, and as a result in step **282** a visual-only response is generated for the frequency band including the selected frequency block. If, however, the selected frequency block does not have a source incidence counter greater than the silent threshold, or if source incidence counters are not implemented, then an audible and visual response can be generated. In step **284** it is determined whether the receiver is in "warning suppression" mode. If not in this mode, then an audible and visual response is generated for the band of signals including the selected frequency block. Visual response may be a normal response or may be an "expert meter" response depending upon the status of the "expert meter" mode of the receiver.

After steps **282** or **284**, or immediately after steps **276** or **278** if a frequency block is to be ignored or has been locked out, in step **285** it is determined whether there are additional frequency blocks to be evaluated. If so, then in step **286** the next frequency block is selected and processing returns to step **276**. After all frequency blocks have been evaluated, processing ends at step **285**, and the generation of audible and visual responses is completed.

Returning to step **270**, if one of the location lockout, minimal visual lockout or always warn flags are set for the current location, then in step **290** and in step **292** it is determined which of these flags is set. If the "always warn" flag is set for the current cell, then in step **288** an audible and visual response is generated for all frequencies identified by the received, unless suppressed by "warning suppression mode". Step **288** is also performed following step **272** if there is no match for the current location in the signal information database.

If the "minimal visual" flag is set for a current location, but the "always warn" flag is not, processing proceeds from step **290** to step **292** and then to step **294** in which a minimal visual response is generated for all frequencies identified by the receiver, such as a small blinking flag on the display of the detector.

If the "always warn" and "minimal visual" flags are not set, but the "location lockout" flag is set for the current location, then processing continues from step **270** through steps **290** and **292** to step **296**, in which a visual-only response is generated for all frequencies identified by the receiver, which may include expert meter information or other details available from the detector.

After step **288**, **294** or **296** processing to generate an audible and/or visual response is completed.

In known radar detectors there are two threshold sensitivity modes, "highway" and "city". Further, known radar detectors have included a function for X & K Signal Filtering, which suppresses warnings for signals received simultaneously on both the X and K bands, as indicative of a non-police radar source. A radar detector in accordance with the present invention incorporates a sensitivity control (as part of keypad **36**) with three settings: "Highway (HWY)", "Auto", and "City". FIG. **7**A illustrates the functions that are active for a selected sensitivity mode. As illustrated in FIG. **7**A, a Slow Speed Cancellation function is active in the "auto" and "highway" modes. An X&K filter function is active in the "auto" mode. Reduced gain for city driving is active for the "city" mode. The present invention thus combines user input and previously described speed-based input to establish threshold sensitivity in the "city" and "auto" modes. FIG. **7**B illustrates the Slow Speed Cancellation function, and in particular the relationship between threshold and speed for the Slow Speed Cancellation function. The sensitivity is at its lowest, i.e. the warning threshold is at its highest, when the vehicle speed is below 15 mph. Above 45 mph the sensitivity is greatest and the threshold is set to zero. The X&K band filter, as noted above, cancels simultaneous X&K band signals as suggestive of a door opener or other non-police radar source. The city gain function reduces the gain to an appropriate level for city driving.

While the present invention has been illustrated by a description of various embodiments and while these embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art.

For example, it will be appreciated that principles of the present invention may also be applied to systems that do not include a GPS receiver. For example, in a simplified embodiment of the present invention, the radar warning receiver may automatically enter its "warning suppression" mode based upon the speed of the vehicle. The speed of the vehicle may, of course, be obtained from a GPS receiver, but if a GPS receiver is not available and/or unnecessarily expensive to include in the receiver, the receiver could obtain vehicle speed information directly from the vehicle's on-board information processing system via the OBD II interface discussed above. A threshold speed of 15 MPH could be used as a default, with "warning suppression" mode automatically engaged at speeds below this threshold. This threshold may be user-adjustable, e.g., within a range such as 5 to 50 MPH.

The interface connector used by the receiver may take other forms than the known USB standard. It may use any computer interface standard (e.g., IEEE 488), or an automotive wiring standard, the J1854, CAN, BH12 and LIN standards, or others.

In a more refined embodiment, a "everyday route" mode could be included, in which the operator can perform "everyday route velocity" training. In this "everyday route velocity" training mode, the vehicle speed at each point along the "everyday route" would be stored along with the cell locations along the route. Subsequently, when the detector determines that it is on a previously defined everyday route, it will enter "warning suppression" mode whenever the vehicle speed is within a tolerance of, or below, the velocity recorded when in "everyday route velocity" training mode. Thus, no warning signals will be generated so long as the vehicle is not traveling faster than the threshold speed identified by the operator during "everyday route velocity" training of the detector.

It will be further appreciated that the determination of whether to generate an audible or visual response, or both, may be based on information in addition to the flags applicable to the current cell of the vehicle. For example, the flags in cells recently traversed by the vehicle may also be consulted to determine whether audible or visual signals should be suppressed at a current cell. Thus, for example, if the detector passes through a cell that has been marked for "minimal visual" lockout, warnings will be suppressed for subsequent cells entered by the vehicle while the same signal is being tracked, regardless of whether flag bits in those cells call for a lockout.

The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and method, and illustrative example shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of applicant's general inventive concept.

What is claimed is:

1. A police activity detector comprising:
a receiver section receiving signals generated in the context of law enforcement activity, and
a warning section responding to the receiver section and providing a warning if a received signal correlates to a law enforcement signal;
the detector receiving signals indicative of vehicle motion from a position determining circuit,
the detector being responsive to a warning suppression mode to suppress said warning and continue suppression thereof until at least said signals indicative of vehicle motion indicate vehicle motion over a distance.

2. The police activity detector of claim **1** wherein the receiver section receives electromagnetic radar signals in a radar band.

3. The police activity detector of claim **1** wherein the receiver section receives signals carried in the visible or infrared spectrum.

4. The police activity detector of claim **1** further comprising an interface for reading vehicle motion signals from the position determining circuit on a host vehicle.

5. The police activity detector of claim **4** wherein the interface is an OBDII compliant interface.

6. The police activity detector of claim **4** wherein the interface is an IVBD compliant interface.

7. The police activity detector of claim **1** further comprising an interface reading the vehicle speed data from a position determining circuit in a host vehicle.

8. The police activity detector of claim **7** wherein the interface is an OBDII compliant interface.

9. The police activity detector of claim **7** wherein the interface is an IVBD compliant interface.

10. The police activity detector of claim **1** wherein the warning section is a visible display that makes visible warnings.

11. The police activity detector of claim **1** wherein the warning section is an audio speaker that makes audible warnings.

12. The police activity detector of claim **1** further comprising a position determining circuit generating said signals indicative of vehicle location and speed.

13. The police activity detector of claim **1** wherein the detector is further responsive to said warning suppression mode to suppress said warning and continue suppression thereof until a period of time elapses without receipt of a particular signal by said receiver section.

14. A police activity detector comprising:
a receiver section receiving signals generated in the context of law enforcement activity; and
a warning section responding to a signal received by the receiver section greater than a threshold strength, and providing a warning if a received signal correlates to a law enforcement signal,
the warning section determining the threshold strength in relation to vehicle speed data and input from a user of the detector.

15. The police activity detector of claim **14** wherein the receiver section receives electromagnetic radar signals in a radar band.

16. The police activity detector of claim **14** wherein the receiver section receives signals carried in the visible or infrared spectrum.

17. The police activity detector of claim **14** further comprising an interface reading vehicle speed data from a host vehicle.

18. The police activity detector of claim **17** wherein the interface is an OBDII compliant interface.

19. The police activity detector of claim **17** wherein the interface is an IVBD compliant interface.

20. The police activity detector of claim **14** further comprising an interface reading the vehicle speed data from a position determining circuit in a host vehicle.

21. The police activity detector of claim **20** wherein the interface is an OBDII compliant interface.

22. The police activity detector of claim **20** wherein the interface is an IVBD compliant interface.

23. The police activity detector of claim **14** wherein the warning section is a visible display that makes visible warnings.

24. The police activity detector of claim **14** wherein the warning section is an audio speaker that makes audible warnings.

25. The police activity detector of claim **14** further comprising a position determining circuit, the warning section utilizing said position determining circuit to identify vehicle speed.

26. The police activity detector of claim **14** wherein said input from a user is the selection of a desired sensitivity by the user.

27. The police activity detector of claim **26** wherein said input from a user comprises one or more of: selection of a city sensitivity, selection of a highway sensitivity, and selection of a automatic sensitivity.

28. A police activity detector comprising:
a receiver section adapted to receive electromagnetic signals indicative of police activity;
an alert section responsive to the receiver section and adapted to provide an alert if a received electromagnetic signal correlates to a police signal;
a display for displaying information to a user;
a speed determining circuit generating a vehicle speed signal;
wherein information presented on said display includes information relating to vehicle speed, and
wherein the speed determining circuit determines vehicle speed from movement identified by a position determining circuit.

29. The police activity detector of claim **28**, wherein said electromagnetic signals include radar signals in a radar band.

30. The police activity detector of claim **28**, wherein said electromagnetic signals are carried in the visible or infrared spectrum.

31. The police activity detector of claim **28** wherein said vehicle speed information is presented on said display in conjunction with the provision of an alert by the alert section.

32. The police activity detector of claim **28** wherein said vehicle speed information is presented on said display in response to user input.

33. The police activity detector of claim **28** wherein said receiver incorporates said position determining circuit.

34. The police activity detector of claim **28** further comprising an external interface, wherein movement information is obtained from a position determining circuit via said external interface.

35. The police activity detector of claim **34** wherein the interface is an OBDII compliant interface.

36. The police activity detector of claim **34** wherein the interface is an IVBD compliant interface.

37. The police activity detector of claim **28**, further comprising an external interface, wherein the speed determining circuit determines vehicle speed from information received via said external interface.

38. The police activity detector of claim **37** wherein the interface is an OBDII compliant interface.

39. The police activity detector of claim **37** wherein the interface is an IVBD compliant interface.

40. A police activity detector comprising:

a receiver section adapted to receive electromagnetic signals indicative of police activity;

an alert section responsive to the receiver section and adapted to provide an alert if a received electromagnetic signal correlates to a police signal;

a digital interface connector compliant with the mini-B USB standard;

wherein said police activity detector is configurable in response to digital signals received via said digital interface connector.

41. The police activity detector of claim **40**, wherein said electromagnetic signals include radar signals in a radar band.

42. The police activity detector of claim **40**, wherein said electromagnetic signals are carried in the visible or infrared spectrum.

43. The police activity detector of claim **40** wherein said interface connector is connectable to a digital computer for configuration of said detector.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,576,679 B1
APPLICATION NO. : 11/620443
DATED : August 18, 2009
INVENTOR(S) : Steven K. Orr et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1, line 43, change “band” to --bands--.

Column 1, line 48, change “DSP=s” to --DSP’s--.

Column 1, line 50, change “DSP=s” to --DSP’s--.

Column 2, line 26, change “was” to --were--.

Column 2, line 28, change “>polluters=” to --‘polluters’--.

Column 2, line 33, change “product=s” to --product’s--.

Column 4, line 27, change “maintain” to --maintains--.

Column 4, line 42, change “DRAWING” to --DRAWINGS--.

Column 4, line 57, change “a illustration” to --an illustration--.

Column 6, line 29, change “receiver=s” to --receiver’s--.

Column 7, line 62, change “navigation system” to --navigation system.--.

Column 10, line 32, change “rapidly compares” to --rapidly compare--.

Column 10, line 53, change “detector=s” to --detector’s--.

Column 12, line 58, change “show” to --shows--.

Column 13, line 41, change “were” to --was--.

Signed and Sealed this

Twenty-ninth Day of June, 2010

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

Column 13, line 52, change “a give area” to --a given area--.

Column 14, line 63, before as; add --is--.

Column 15, line 25, change “records” to --record--.

Column 15, line 37, delete “a”; after is.

Column 16, line 30, change “at” to --in--.

Column 16, line 49, delete “it”; after upon.

Column 17, line 44, add --are--; before selected.

Column 19, line 26, change “routes are traversed.” to --routes is traversed.--.

Column 19, line 28, add --of--; after beginning.

Column 20, line 33, change “steps 132” to --step 132--.

Column 23, line 2, delete “of”; after confirm.

Column 23, line 5, change “is” to --are--.

Column 24, line 9, change “non GPS” to --nonGPS--.

Column 24, line 18, change “non GPS” to --nonGPS--.

Column 25, line 2, change “signals” to --signal--.

Column 25, line 29, change “received” to --receiver--.

Column 26, line 66, change “applicant’s” to --applicants’--.

EXHIBIT 5

US006670905B1

(12) United States Patent
Orr

(10) Patent No.: **US 6,670,905 B1**
(45) Date of Patent: **Dec. 30, 2003**

(54) **RADAR WARNING RECEIVER WITH POSITION AND VELOCITY SENSITIVE FUNCTIONS**

(75) Inventor: **Steven K. Orr**, Cincinnati, OH (US)

(73) Assignee: **Escort Inc.**, Cincinnati, OH (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/889,656**

(22) PCT Filed: **Jun. 14, 2000**

(86) PCT No.: **PCT/US00/16410**

§ 371 (c)(1),
(2), (4) Date: **Mar. 15, 2002**

(87) PCT Pub. No.: **WO00/77539**

PCT Pub. Date: **Dec. 21, 2000**

Related U.S. Application Data

(60) Provisional application No. 60/145,394, filed on Jul. 23, 1999, and provisional application No. 60/139,097, filed on Jun. 14, 1999.

(51) **Int. Cl.**[7] **G01S 7/40**; G01S 13/00

(52) **U.S. Cl.** **342/20**; 342/89; 342/175; 342/195; 342/357.01; 342/357.06; 701/207; 701/213

(58) **Field of Search** 701/207, 213, 701/214–216; 342/20, 175, 195, 357.01–357.17, 104, 105, 109–118, 127–146, 159–164, 89, 91–93; 700/90; 340/988, 425.5, 438

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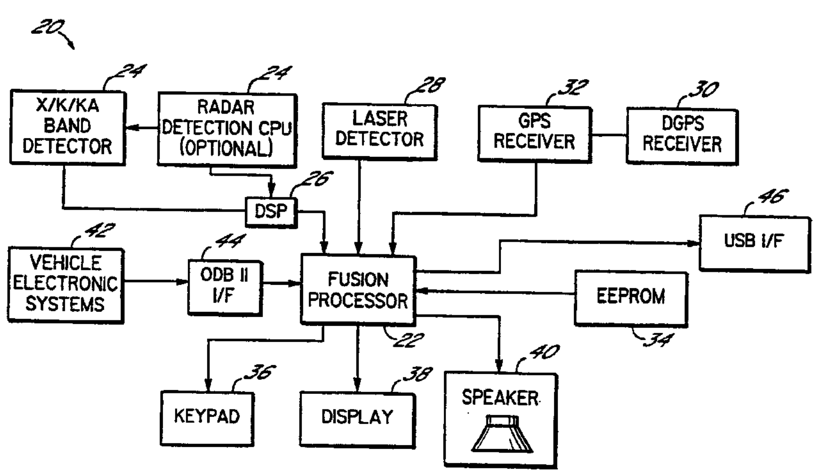
Primary Examiner—Bernarr E. Gregory
(74) *Attorney, Agent, or Firm*—Wood, Herron & Evans, LLP

(57) **ABSTRACT**

A GPS enabled radar detector (**20**) that aids in the management of unrelated or otherwise unimportant sources (**16**), permitting the detector to dynamically improve its handling of such sources based upon previously-stored geographically-referenced information on such sources. The detector includes technology (**30**, **32**) for determining the location of the detector, and comparing this location to the locations of known stationary sources, to improve the handling of such detections. The detector may ignore detections received in an area known to contain a stationary source, or may only ignore specific frequencies or may handle frequencies differently based upon historic trends of spurious police radar signals at each frequency. A Global Positioning Satellite System (GPS) receiver (**30, 32**) is used to establish current physical coordinates. The detector maintains a list (**50**, **82**) of the coordinates of the known stationary source "offenders" in nonvolatile memory. Each time a microwave or laser source is detected, it will compare its current coordinates to this list. Notification of the driver will take on a variety of forms depending on the stored information and current operating modes.

85 Claims, 8 Drawing Sheets



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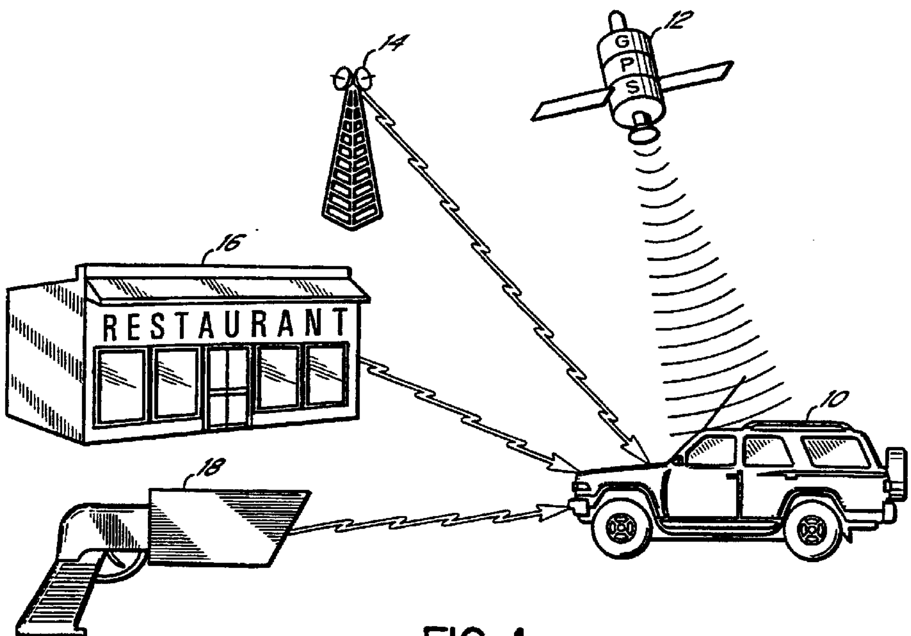

14
12
G
P
S
16
RESTAURANT
10
18

FIG. 1

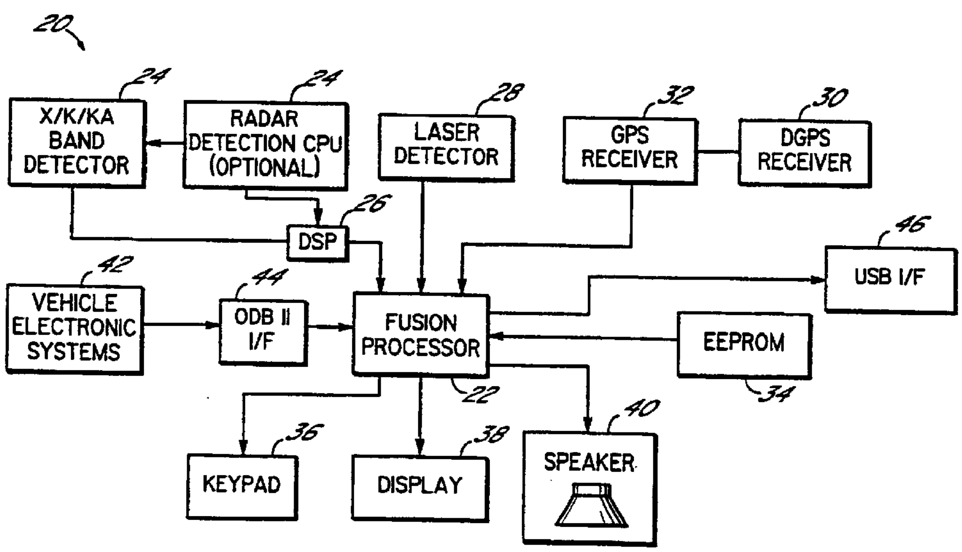

20
24
X/K/KA BAND DETECTOR
24
RADAR DETECTION CPU (OPTIONAL)
28
LASER DETECTOR
32
GPS RECEIVER
30
DGPS RECEIVER
26
DSP
46
USB I/F
42
VEHICLE ELECTRONIC SYSTEMS
44
ODB II I/F
FUSION PROCESSOR
22
EEPROM
34
40
36
KEYPAD
38
DISPLAY
SPEAKER

FIG. 2

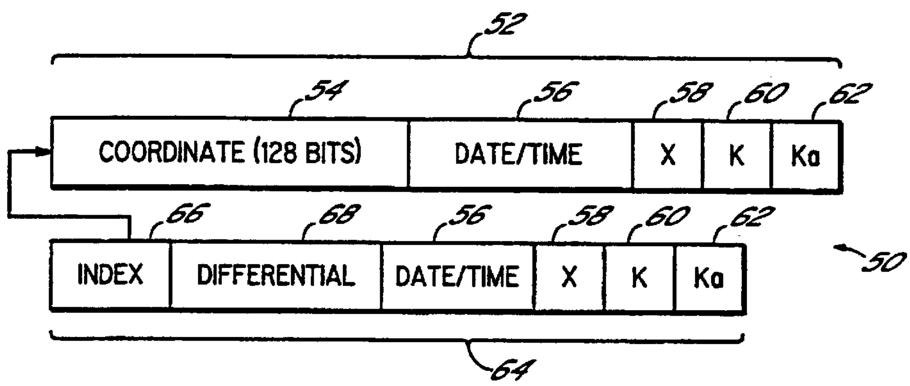


FIG. 3

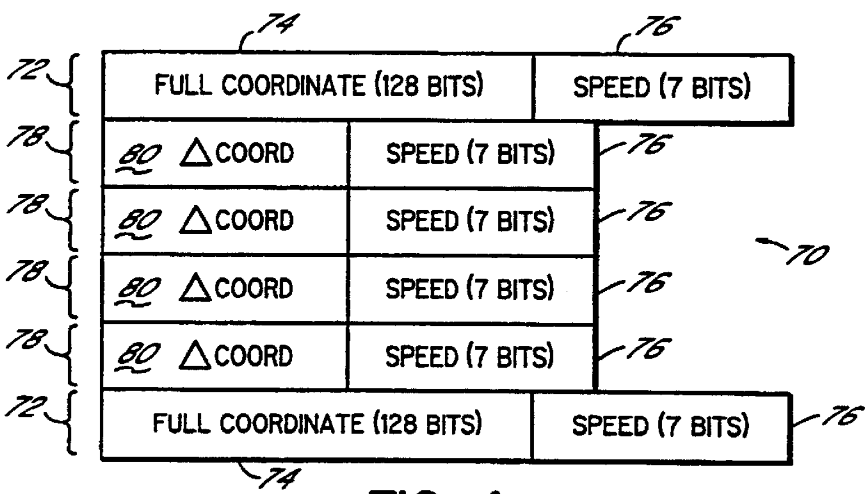


FIG. 4

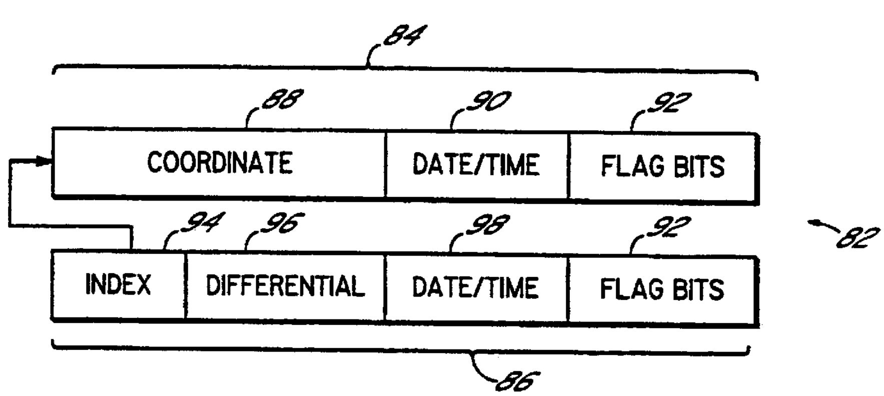


FIG. 5

FIG. 6A

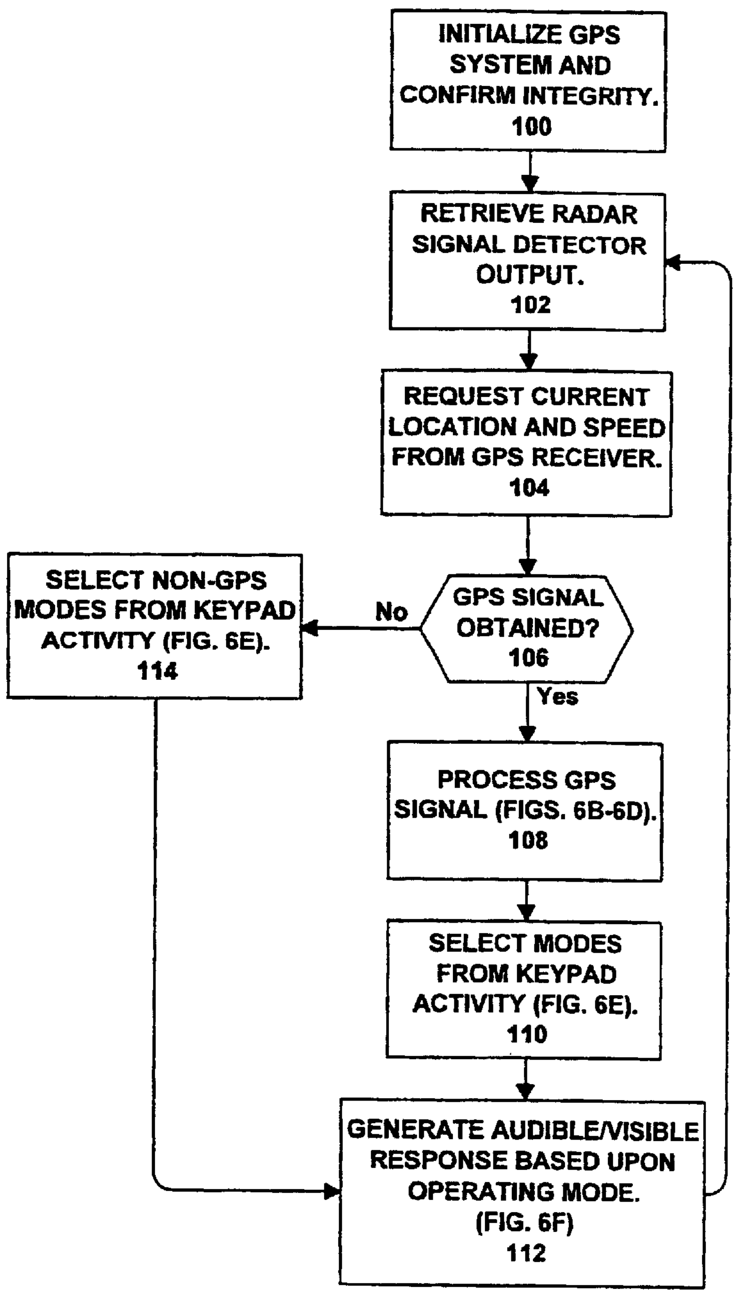

INITIALIZE GPS SYSTEM AND CONFIRM INTEGRITY. 100
RETRIEVE RADAR SIGNAL DETECTOR OUTPUT. 102
REQUEST CURRENT LOCATION AND SPEED FROM GPS RECEIVER. 104
GPS SIGNAL OBTAINED? 106
No
Yes
SELECT NON-GPS MODES FROM KEYPAD ACTIVITY (FIG. 6E). 114
PROCESS GPS SIGNAL (FIGS. 6B-6D). 108
SELECT MODES FROM KEYPAD ACTIVITY (FIG. 6E). 110
GENERATE AUDIBLE/VISIBLE RESPONSE BASED UPON OPERATING MODE. (FIG. 6F) 112

FIG. 6B

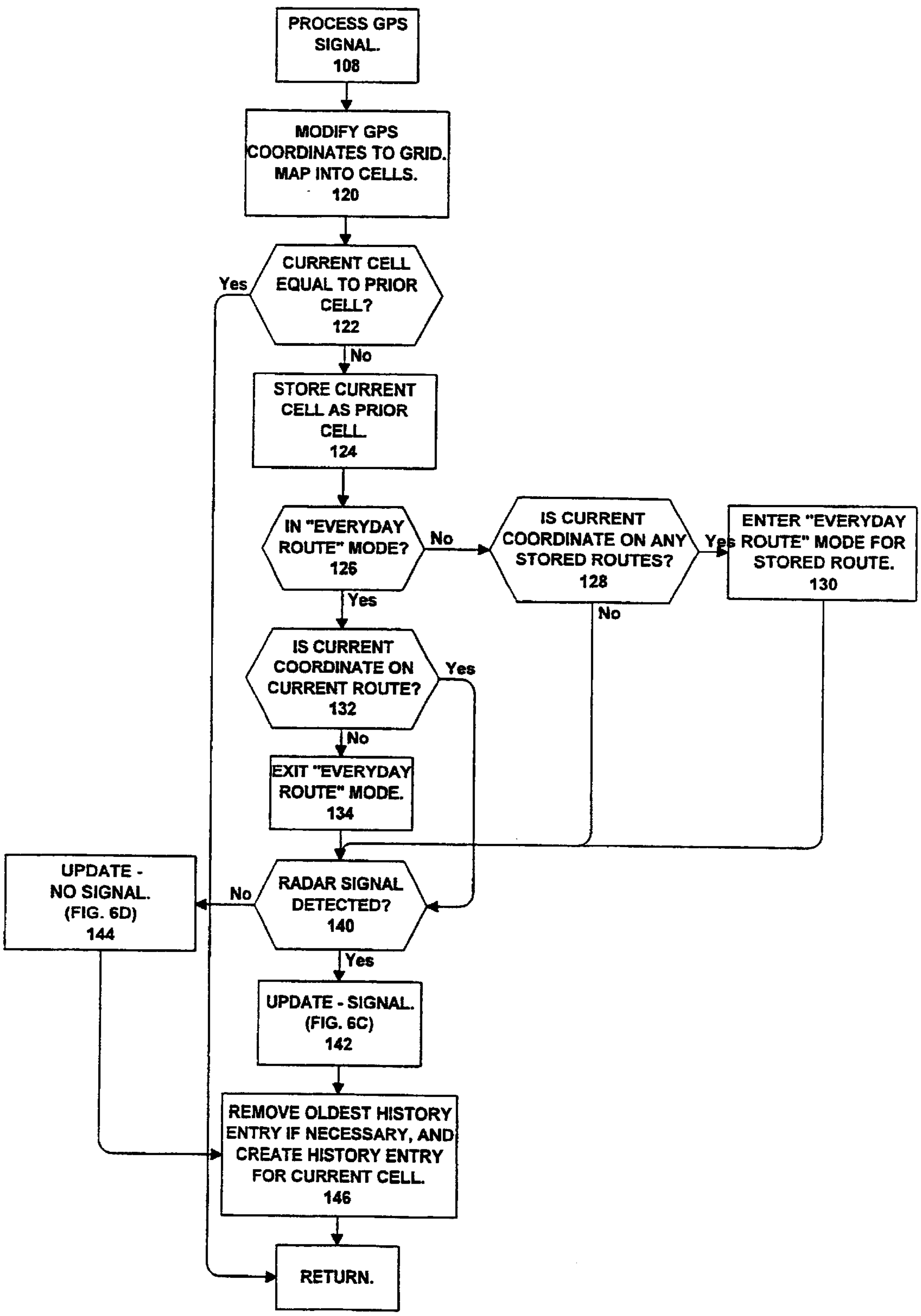

PROCESS GPS SIGNAL. 108
MODIFY GPS COORDINATES TO GRID. MAP INTO CELLS. 120
CURRENT CELL EQUAL TO PRIOR CELL? 122
Yes
No
STORE CURRENT CELL AS PRIOR CELL. 124
IN "EVERYDAY ROUTE" MODE? 126
No
IS CURRENT COORDINATE ON ANY STORED ROUTES? 128
Yes
ENTER "EVERYDAY ROUTE" MODE FOR STORED ROUTE. 130
No
Yes
IS CURRENT COORDINATE ON CURRENT ROUTE? 132
Yes
No
EXIT "EVERYDAY ROUTE" MODE. 134
UPDATE - NO SIGNAL. (FIG. 6D) 144
No
RADAR SIGNAL DETECTED? 140
Yes
UPDATE - SIGNAL. (FIG. 6C) 142
REMOVE OLDEST HISTORY ENTRY IF NECESSARY, AND CREATE HISTORY ENTRY FOR CURRENT CELL. 146
RETURN.

FIG. 6C

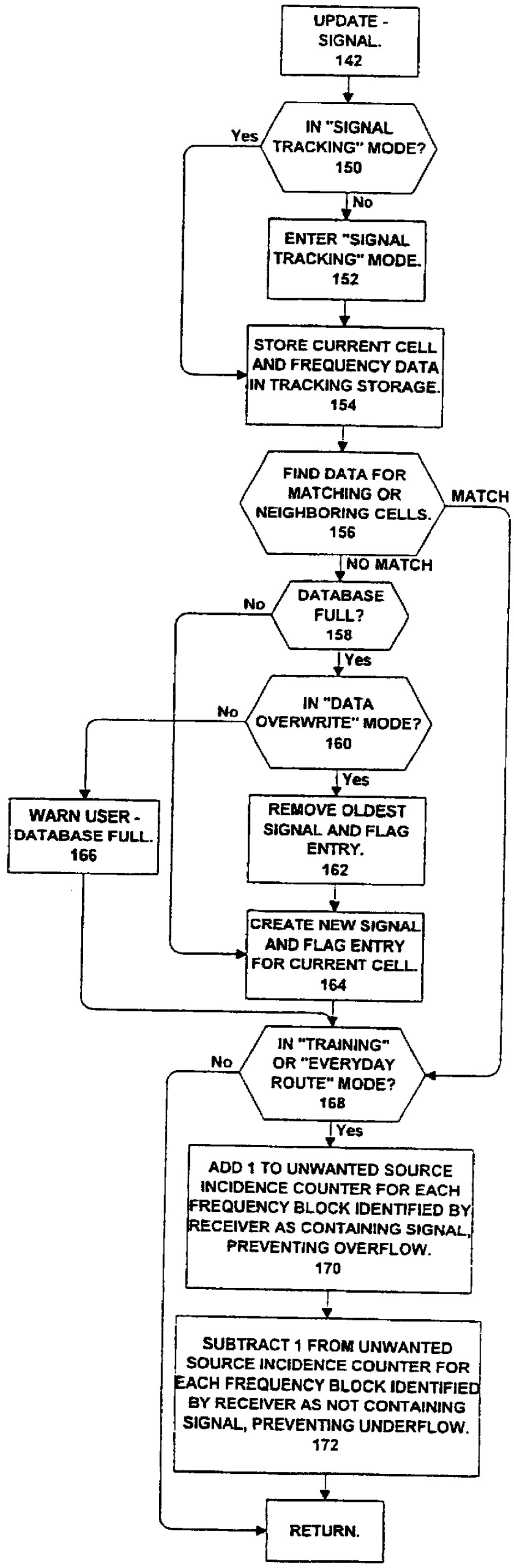
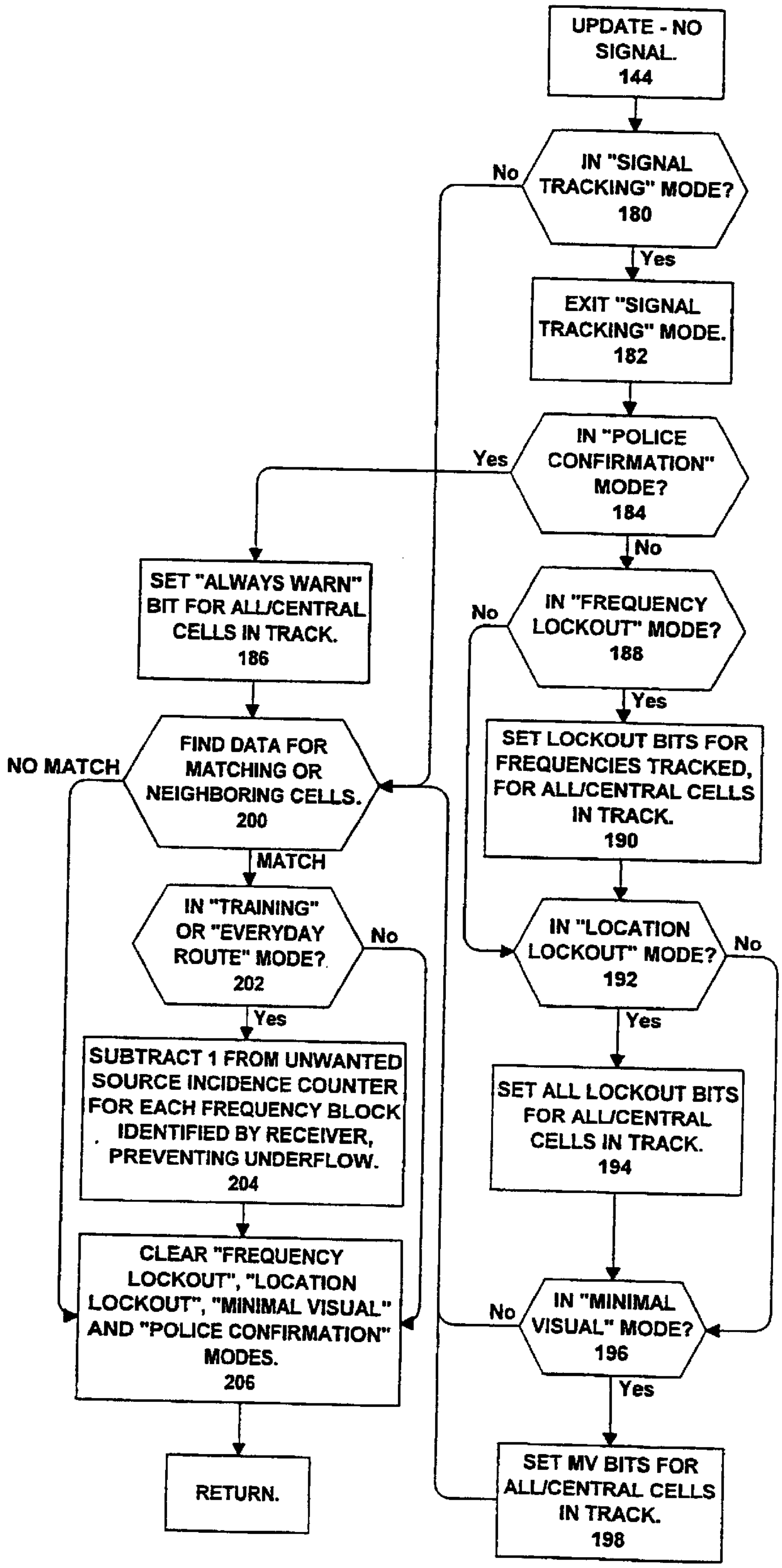

UPDATE - SIGNAL. 142
IN "SIGNAL TRACKING" MODE? 150
Yes
No
ENTER "SIGNAL TRACKING" MODE. 152
STORE CURRENT CELL AND FREQUENCY DATA IN TRACKING STORAGE. 154
FIND DATA FOR MATCHING OR NEIGHBORING CELLS. 156
MATCH
NO MATCH
DATABASE FULL? 158
No
Yes
IN "DATA OVERWRITE" MODE? 160
No
Yes
WARN USER - DATABASE FULL. 166
REMOVE OLDEST SIGNAL AND FLAG ENTRY. 162
CREATE NEW SIGNAL AND FLAG ENTRY FOR CURRENT CELL. 164
IN "TRAINING" OR "EVERYDAY ROUTE" MODE? 168
No
Yes
ADD 1 TO UNWANTED SOURCE INCIDENCE COUNTER FOR EACH FREQUENCY BLOCK IDENTIFIED BY RECEIVER AS CONTAINING SIGNAL, PREVENTING OVERFLOW. 170
SUBTRACT 1 FROM UNWANTED SOURCE INCIDENCE COUNTER FOR EACH FREQUENCY BLOCK IDENTIFIED BY RECEIVER AS NOT CONTAINING SIGNAL, PREVENTING UNDERFLOW. 172
RETURN.

FIG. 6D


UPDATE - NO SIGNAL. 144
IN "SIGNAL TRACKING" MODE? 180
No
Yes
EXIT "SIGNAL TRACKING" MODE. 182
IN "POLICE CONFIRMATION" MODE? 184
Yes
No
SET "ALWAYS WARN" BIT FOR ALL/CENTRAL CELLS IN TRACK. 186
IN "FREQUENCY LOCKOUT" MODE? 188
No
Yes
SET LOCKOUT BITS FOR FREQUENCIES TRACKED, FOR ALL/CENTRAL CELLS IN TRACK. 190
FIND DATA FOR MATCHING OR NEIGHBORING CELLS. 200
NO MATCH
MATCH
IN "TRAINING" OR "EVERYDAY ROUTE" MODE? 202
No
Yes
IN "LOCATION LOCKOUT" MODE? 192
No
Yes
SUBTRACT 1 FROM UNWANTED SOURCE INCIDENCE COUNTER FOR EACH FREQUENCY BLOCK IDENTIFIED BY RECEIVER, PREVENTING UNDERFLOW. 204
SET ALL LOCKOUT BITS FOR ALL/CENTRAL CELLS IN TRACK. 194
CLEAR "FREQUENCY LOCKOUT", "LOCATION LOCKOUT", "MINIMAL VISUAL" AND "POLICE CONFIRMATION" MODES. 206
IN "MINIMAL VISUAL" MODE? 196
No
Yes
RETURN.
SET MV BITS FOR ALL/CENTRAL CELLS IN TRACK. 198

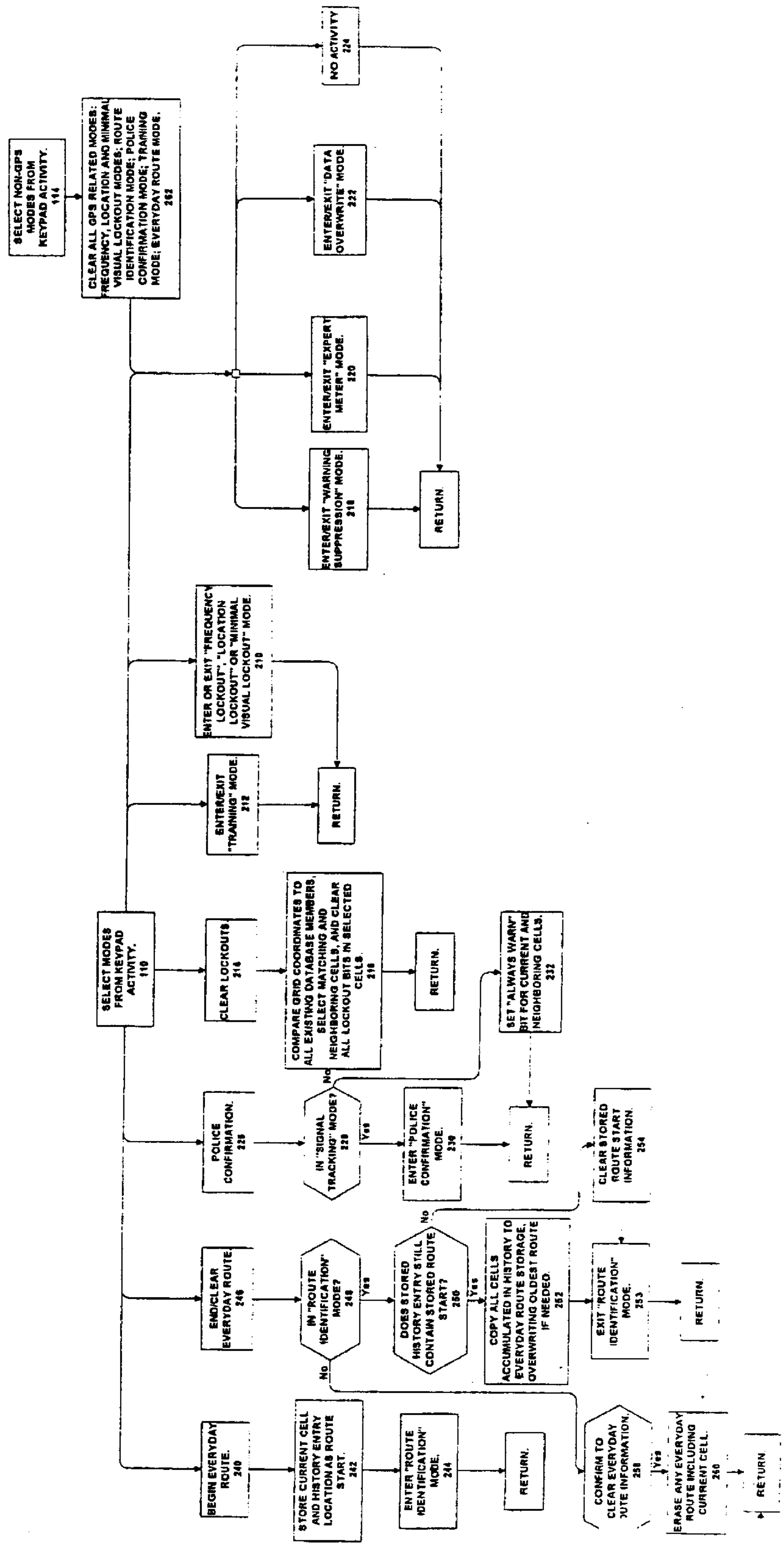
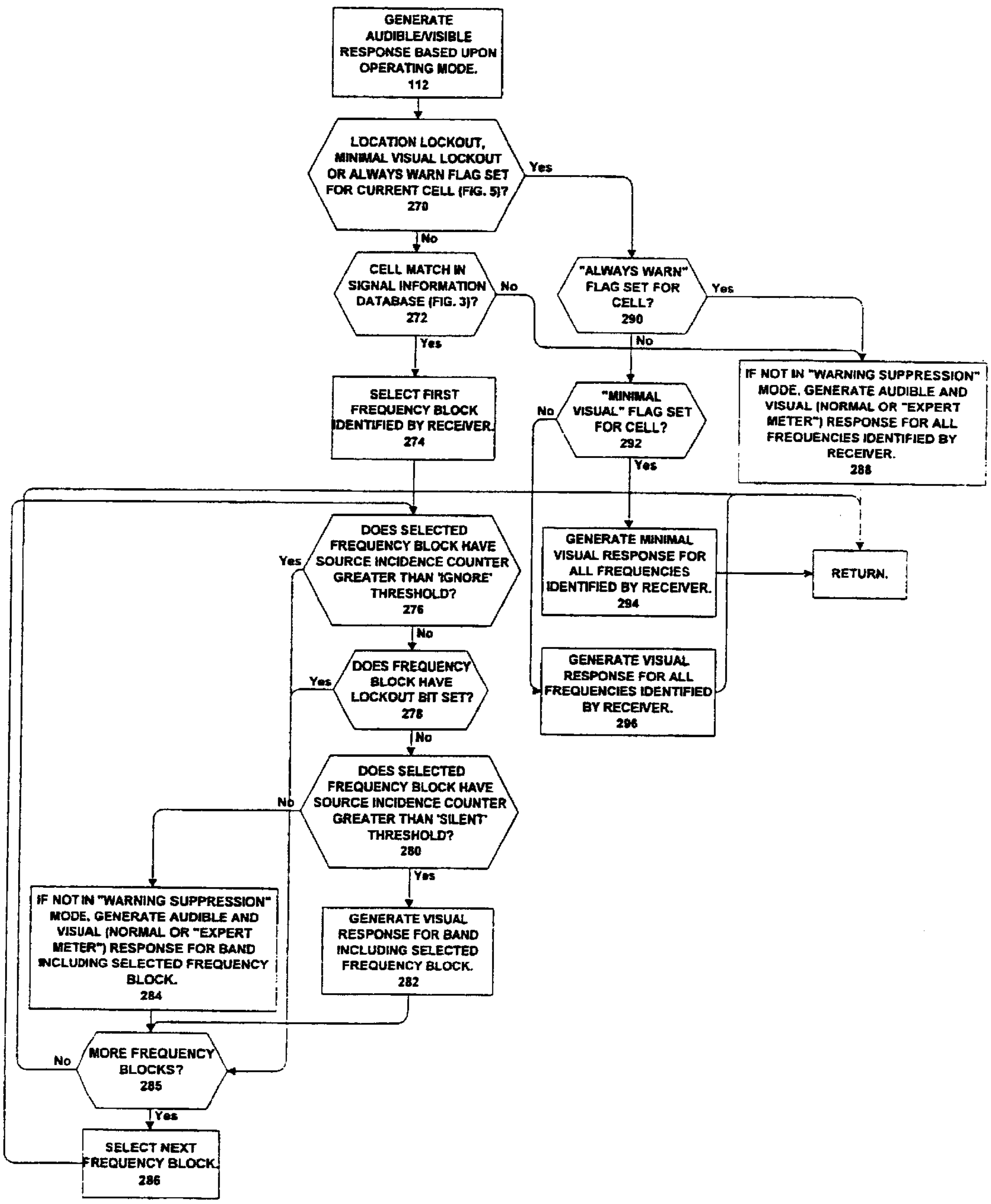


FIG. 6E

FIG. 6F


GENERATE AUDIBLE/VISIBLE RESPONSE BASED UPON OPERATING MODE. 112
LOCATION LOCKOUT, MINIMAL VISUAL LOCKOUT OR ALWAYS WARN FLAG SET FOR CURRENT CELL (FIG. 5)? 270
Yes
No
CELL MATCH IN SIGNAL INFORMATION DATABASE (FIG. 3)? 272
"ALWAYS WARN" FLAG SET FOR CELL? 290
IF NOT IN "WARNING SUPPRESSION" MODE, GENERATE AUDIBLE AND VISUAL (NORMAL OR "EXPERT METER") RESPONSE FOR ALL FREQUENCIES IDENTIFIED BY RECEIVER. 288
SELECT FIRST FREQUENCY BLOCK IDENTIFIED BY RECEIVER. 274
"MINIMAL VISUAL" FLAG SET FOR CELL? 292
DOES SELECTED FREQUENCY BLOCK HAVE SOURCE INCIDENCE COUNTER GREATER THAN 'IGNORE' THRESHOLD? 276
GENERATE MINIMAL VISUAL RESPONSE FOR ALL FREQUENCIES IDENTIFIED BY RECEIVER. 294
RETURN.
DOES FREQUENCY BLOCK HAVE LOCKOUT BIT SET? 278
GENERATE VISUAL RESPONSE FOR ALL FREQUENCIES IDENTIFIED BY RECEIVER. 296
DOES SELECTED FREQUENCY BLOCK HAVE SOURCE INCIDENCE COUNTER GREATER THAN 'SILENT' THRESHOLD? 280
IF NOT IN "WARNING SUPPRESSION" MODE, GENERATE AUDIBLE AND VISUAL (NORMAL OR "EXPERT METER") RESPONSE FOR BAND INCLUDING SELECTED FREQUENCY BLOCK. 284
GENERATE VISUAL RESPONSE FOR BAND INCLUDING SELECTED FREQUENCY BLOCK. 282
MORE FREQUENCY BLOCKS? 285
SELECT NEXT FREQUENCY BLOCK. 286

RADAR WARNING RECEIVER WITH POSITION AND VELOCITY SENSITIVE FUNCTIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a United States continuation-in-part of U.S. Provisional Patent Application serial No. 60/139,097, filed Jun. 14, 1999, and a United States continuation-in-part of U.S. Provisional Patent Application serial no. 60/145,394, filed Jul. 23, 1999, both of which are hereby incorporated herein in their entirety.

FIELD OF THE INVENTION

The present invention relates to radar warning receivers.

BACKGROUND OF THE INVENTION

Radar detectors warn drivers of the use of police radar, and the potential for traffic citations if the driver exceeds the speed limit. The FCC has allocated several regions of the electromagnetic spectrum for police radar use. The bands used by police radar are generally know as the X, K and Ka bands. Each relates to a different part of the spectrum. The X and K bands are relatively narrow frequency ranges, whereas the Ka band is a relatively wide range of frequencies. By the early 1990's, police radar evolved to the point that it could operate almost anywhere in the 1600-megahertz wide Ka band. During that time radar detectors kept pace with models that included descriptive names like "Ultra Wide" and "Super Wide." More recently, police have begun to use laser (optical) systems for detecting speed. This technology was termed LIDAR for "Light Detection and Ranging."

Radar detectors typically comprise a microwave receiver and detection circuitry that is typically realized with a microprocessor or digital signal processor (DSP). Microwave receivers are generally capable of detecting microwave components in the X, K, and very broad Ka band. In various solutions, either a microprocessor or DSP is used to make decisions about the signal content from the microwave receiver. Systems including a digital signal processor have been shown to provide superior performance over solutions based on conventional microprocessors due to the DSP's ability to find and distinguish signals that are buried in noise. Various methods of applying DSP's were disclosed in U.S. Pat. Nos. 4,954,828, 5,079,553, 5,049,885, and 5,134,406, each of which is hereby incorporated by reference herein.

Police use of laser has also been countered with laser detectors, such as described in U.S. Pat. Nos. 5,206,500, 5,347,120 and 5,365.055, each of which is incorporated herein by reference. Products are now available that combined laser detection into a single product with a microwave receiver, to provide comprehensive protection.

The DSP or microprocessor in a modem radar detector is programmable. Accordingly, they can be instructed to manage all of the user interface features such as input switches, lights, sounds, as well as generate control and timing signals for the microwave receiver and/or laser detector. Early in the evolution of the radar detector, consumers sought products that offered a better way to manage the audible volume and duration of warning signals. Good examples of these solutions are found in U.S. Pat. Nos. 4,631,542, 5,164,729, 5,250,951, and 5,300,932, each of which is hereby incorporated by reference, which provide methods for conditioning the response generated by the radar detector.

Methods for conditioning detector response are gaining importance, because there is an increasing number of signals present in the X, K, and Ka bands from products that are completely unrelated to police radar. These products share the same regions of the spectrum and are also licensed by the FCC. The growing number of such signals is rapidly undermining the credibility of radar detector performance. Radar detectors cannot tell the difference between emissions from many of these devices and true police radar systems. As a result, radar detectors are increasingly generating false alarms, effectively "crying wolf", reducing the significance of warnings from radar detectors.

One of the earliest and most prevalent unrelated Microwave sources is the automatic door system used in many commercial buildings such as supermarkets, malls, restaurants and shopping centers. The majority of these operate in the X-Band and produce signals virtually indistinguishable from conventional X-Band Police Radar. Other than the fact that door opening systems are vertically polarized, vs circular polarization for police radar, there is no distinction between the two that could be analyzed and used by a receiver design.

Until recently, virtually all of the door opening systems were designed to operate in the X-Band. As a result, radar detectors generally announced X-Band alerts far more often than K-Band. As these X-Band 'polluters' grew in numbers, ultimately 99% of X-Band alerts were from irrelevant sources. X-Band alerts became meaningless. The only benefit that these sources offered the user was some assurance that the detector was actually capable of detecting radar. It also gave the user some intuition into the product's detection range. To minimize the annoyance to users, most radar detector manufacturers added a filter-like behavior that was biased against X-Band sources. Many also added "Band priority" that was biased against X and in favor of bands that were less likely to contain irrelevant sources such as K, K*a*, and Laser. If signals in both X and K Bands were detected, band prioritization would announce K, since it was more likely be a threat to the driver. In the last few years, K-Band door opening systems have also grown in number. This has reduced the significance of the K-Band warning and further undercut the overall benefit to the user of a radar detector.

Another unrelated microwave signal is generated by traffic management systems such as the ARTIMIS manufactured by TRW, used in Cincinnati, Ohio. ARTIMIS Stands for "Advanced Regional Traffic Interactive Management and Information System", and reports traffic flow information back to a central control center. Traffic congestion and other factors are analyzed by the control center. Control center employees use this information to formulate routing suggestions and other emergency information, which they transmit to a large distribution of overhead and roadside signs. In order to collect information on vehicle traffic, a roadside ARTIMIS station transmits an X-Band signal toward cars as they drive by. The ARTIMIS source, unlike the X-Band door opener systems, is distinguishable from police radar as it is not transmitted at a single fixed frequency. As a result, it is possible to differentiate police radar signals from sources such as ARTIMIS, and ignore ARTIMIS sources in newer detectors. Older detectors, however, do not incorporate this feature and could be obsolete in areas where ARTIMIS is in use.

Unrelated Microwave signals are also transmitted by a system called the RASHID VRSS. Rashid is an acronym for Radar Safety Brake Collision Warning System. This electronic device warns heavy trucks and ambulances of hazards in their path. A small number of these RASHID VRSS units

have been deployed. They are categorized as a member of the 'non-stationary' set of unrelated sources. As in the ARTIMIS example, detection of RASHID can be prevented.

Perhaps the biggest source of non-stationary unrelated sources is from other radar detectors. These are sometimes referred to as "polluting radar detectors," and present a serious threat to some detector products. An early example of this occurred in the mid 1980's when radar detectors using superhomodyne circuitry became popular. Such detectors leak energy in the. X-Band and K-bands and appeared as police radar to other detectors. A solution to this problem is described in U.S. Pat. No. 4,581,769, which is hereby incorporated by reference in its entirety. A similar problem occurred in the early 1990's when the Ka band was widened. An unexpected result was that the wider Ka band then also detected harmonics of signals generated by local oscillators within many existing radar detectors. U.S. Pat. No. 5,305,007, which is hereby incorporated by reference in its entirety, describes a method for ignoring these polluting detectors.

At this time, there are very few signal sources that can cause false laser detections in comparison to the substantial list of false microwave signals just described. However there are certain types of equipment that can cause the amplifiers and detection circuitry used in a laser detector to generate a "false" detect. In particular, certain locations near airports have been demonstrated to cause such problems for various laser detector products. As a result, selected airport environments are examples of stationary signals that produce false laser detections.

As can be appreciated from the foregoing example, as sources of unrelated signals continue to propagate, radar detectors must continually increase in sophistication to filter unrelated sources and accurately identify police radar. Each of these changes and enhancements has the potential effect of obsoleting existing detectors that do not include appropriate countermeasures. Furthermore, some sources, particularly stationary door opener sources, at this time cannot be filtered economically, and thus threaten the usefulness of even the most sophisticated modem radar detector.

During the 1980's, the functionality of radar detectors expanded into other classes of driver notification. A system was developed that required a special transmitter be placed on emergency vehicles, trains, and other driving hazards. The term 'emergency radar' was coined, and a variety of products were introduced that could detect these transmitters. One such solution was disclosed in U.S. Pat. No. 5,559,508, which is hereby incorporated by reference herein in its entirety. Another system was later introduced offering a larger class of 'hazard categories' called the SWS system. Both emergency radar and SWS involve the transmission of microwave signals in the 'K' band. Such signals are considered to be a part of the group of signal types that are intended to be detected by radar detectors.

A drawback of these warning systems is that stationary transmitters of these signals send the same message to drivers constantly, and become a nuisance during daily commute. This is beneficial to 'new' drivers receiving the message for the first time. However these messages become an annoyance to drivers who follow the same path to work everyday.

Thus, radar detector manufacturers are continually confronted with new problems to solve, due to the variety of different types of unrelated sources and their sheer numbers. The rate at which new or upgraded radar detector models are introduced continues to increase as manufacturers try to evolve their products to manage the growing number of unrelated sources. Meanwhile, the market for radar detectors is shrinking because consumers are no longer interested in buying products that so quickly become obsolete.

SUMMARY OF THE INVENTION

The present invention overcomes these difficulties by providing a method of operating a radar detector that aids in the management of unrelated sources, and permitting the detector to dynamically improve its handling of unrelated sources. As noted above, many non-stationary sources can be identified and ignored using existing technology. However, many stationary sources cannot, as yet be effectively filtered economically with existing technology. Accordingly, the invention provides a radar detector that includes technology for determining the location of the detector, and comparing this location to the locations of known stationary sources, to improve the handling of such detections.

In one embodiment, a radar detector may ignore detections received in an area known to contain a stationary source. In the specific embodiment described below, substantially more sophisticated processing is performed to determine whether and what actions to take in response to a detection.

The Global Positioning Satellite System (GPS) offers an electronic method for establishing current physical coordinates very accurately. In the detailed embodiment described below, a radar detector utilizes a GPS system to determine its current position. The detector also maintain a list of the coordinates of the known stationary source "offenders" in nonvolatile memory. Each time a microwave or laser source is detected, it will compare its current coordinates to this list. Notification of the driver will take on a variety of forms depending on the setup configuration.

By adding GPS conditioning capabilities to a radar detector, the combination becomes a new product category that is capable of rejecting signals from any given location no matter what the nature of the microwave/laser signals might be from that location. This will have a dramatic effect on the usable life of the product and subsequent value to its owner.

The above and other objects and advantages of the present invention shall be made apparent from the accompanying drawings and the description thereof

BRIEF DESCRIPTION OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with a general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the invention.

FIG. **1** is an illustration of a vehicle receiving radar signals from police radar and from a number of unrelated sources, and further receiving global positioning signals from a global positioning satellite;

FIG. **2** is an electrical block diagram of a radar detection circuit in accordance with principles of the present invention;

FIG. **3** is a illustration of a database structure used by the radar detection circuit of FIG. **2**, for storing information radar signals received or receivable from unrelated sources at a number of locations, as identified by cell coordinates;

FIG. **4** is an illustration of a database structure used for storing historic information on the locations of a vehicle

carrying the radar detection circuit of FIG. 2, as identified by cell coordinates;

FIG. 5 is an illustration of a database structure used for storing flags identifying various conditions at a number of locations, as identified by cell coordinates;

FIG. 6A is a flow chart of the operations of the CPU of the radar detector of FIG. 2, carrying out principles of the present invention;

FIG. 6B is a flow chart of operations of the CPU of FIG. 2 in processing GPS information when GPS signals are being received;

FIG. 6C is a flow chart of operations of the CPU of FIG. 2 in updating stored information when a radar signal is being received;

FIG. 6D is a flow chart of operations of the CPU of FIG. 2 in updating stored information when a radar signal is not being received;

FIG. 6E is a flow chart of operations of the CPU of FIG. 2 in responding to keypad activity to change operative mode of the GPS enabled radar detector; and

FIG. 6F is a flow chart of operations of the CPU of FIG. 2 in generating audible and visible responses based upon operating modes of the radar detector and the presence or absence of radar signals and stored information.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

To provide background for the present invention, a summary of GPS (Global Positioning System) technology will now be provided. GPS is a mature technology that provides a method for a GPS receiver to determine its relative location and velocity at any time. The (GPS) system is a worldwide constellation of 24 satellites and their ground stations. GPS receivers on earth use 'line of sight' information from these satellites as reference points to calculate positions accurate to a matter of meters. Advanced forms of GPS actually enable measurements to within a centimeter. The Global Positioning System consists of three segments: a space segment of 24 orbiting satellites, a control segment that includes a control center and access to overseas command stations, and a user segment, consisting of GPS receivers and associated equipment. Over time GPS receivers have been miniaturized to just a few integrated circuits and have become very economical.

An unfortunate side effect of the GPS system is that it can be used by enemy forces, as GPS signals can be picked up by any receiver including both domestic and foreign. When the United States Department of Defense devised the GPS system they incorporated a feature that prevents high precision measurements unless the receiver is equipped with special military 'keys.' This is accomplished with the intentional introduction of "noise" into the satellite's clock data which adds noise (or inaccuracy) into position calculations. The DOD sometimes also sends slightly erroneous orbital data to the satellites, which is transmitted back to receivers on the ground. This intentional degradation is referred to as "Selective Availability" or "SA" error. Military receivers use a decryption key to remove the SA errors. As a result of the SA error, there are two classes of GPS service, "Standard Positioning Service (SPS) and "Precise Positioning System" (PPS.). These classes are realized by having GPS satellites transmit two different signals: the Precision or P-code and the Coarse Acquisition or C/A-code. The P-code is designed for authorized military users and provides PPS service. To ensure that unauthorized users do not acquire the P-code, the DOD can engage an encryption segment on the P-code called anti-spoofing (AS). The C/A-code is designed for use by nonmilitary users and provides SPS service. The C/A-code is less accurate and easier to jam than the P-code. It is also easier to acquire, so military receivers first track the C/A-code and then transfer to the P-code. Selective availability is achieved by degrading the accuracy of the C/A-code.

The precision of SPS is stated as providing 100-meter horizontal and 156 meter vertical accuracy "95% of the time." PPS is only available for the U.S. and allied military, certain U.S. Government agencies, and selected civil users specifically approved by the U.S. Government. PPS provides 22 meters horizontal and 22.7 meters vertical accuracy 95% of the time.

Other than intentional errors inserted by the DOD, there are a variety of other error sources that vary with terrain and other factors. GPS satellite signals are blocked by most materials. GPS signals will not pass through buildings, metal, mountains, or trees. Leaves and jungle canopy can attenuate GPS signals so that they become unusable. In locations where at least four satellite signals with good geometry cannot be tracked with sufficient accuracy, GPS is unusable.

The "Differential GPS" system was developed in order to compensate for the inaccuracy of GPS readings. A high-performance GPS receiver (known as a reference station or beacon) is placed at a specific location; the information it receives is then compared to the receiver's location and corrects the SA satellite signal errors. The error data is then formatted into a correction message and transmitted to GPS users on a specific frequency (300 kHz). A true or arbitrary set of coordinates are assigned to the position occupied by a reference GPS receiver. The difference between these and the coordinates received via GPS at the reference is a very close approximation to the SA error at nearby sites. This error is nearly identical to the error calculated by any nearby GPS receiver. The reference site is sometimes referred to as a 'beacon,' as it constantly transmits these difference coordinates. A DPGS receiver is designed to receive both the GPS information and the beacon information. It generates a far more accurate estimate of its coordinates by applying the difference information to the GPS coordinates. The drawback to this is that the remote and reference receivers may not be using the same set of satellites in their computations. If this is the case, and the remote receiver incorporates the corrections, it may be accounting for satellite errors that are not included in its own measurement data. These corrections can make the differential solution worse than the uncorrected GPS position. To prevent this error, an improved form of differential GPS involves the derivation of the corrections to the actual measurements made at the reference receiver to each satellite. By receiving all of the corrections independently, the remote receiver can pick and choose which are appropriate to its own observations. This method of DGPS is most widely used. Typically, the DGPS correction signal loses approximately 1 m of accuracy for every 150 km of distance from the reference station.

The availability of Beacons for DGPS systems elevate the very threat that the SA error was intended to reduce. In the presence of such networks, potentially hostile weapons systems using DGPS could be developed relatively rapidly. For this reason and others, the SA error has diminished in military significance. The White House has Directed that the S/A error be "Set to Zero" by the year 2006.

In the United States, the US Coast Guard (USCG) and Army Corps of Engineers (ACE) have constructed a net-

work of Beacon stations that service the majority of the eastern United States, the entire length of both coastlines, and the Great Lakes. Further plans exist to increase the density of this network to provide dual redundant coverage throughout the continental US by the end of the year 2000 for a variety of applications including intelligent transportation system, infrastructure management, and public safety.

The Canadian Coast Guard (CCG) provides coverage in Canada for the St. Lawrence River, throughout the Great Lakes, and both coastlines. In total, there are over 160 stations operational worldwide with over 140 sites proposed to come online within the next two years. Coverage currently exists in many other regions of the world including Europe, Asia, Australia, Africa, and South America.

The beacons perform the differential calculation and broadcasts this information by modulating the data onto a 300 kHz signal transmitted by the established network of Radiobeacons. The advantages of using the Beacon DGPS network include: (1) Free access to differential correction information; (2) Long range signal which penetrates into valleys, and travels around obstacles; (3) High quality differential corrections which are continuously monitored for integrity; and (4) Inexpensive user equipment.

The range of the 300 kHz signal is dependent upon a number of factors which include transmission power and conductivity of the surface over which the transmission is propagating. The Beacons within the global network broadcast at varying power. Typical broadcasting ranges for radiobeacons vary from as little as 35 nautical miles to as much as 300 nautical miles. Signals broadcast by DGPS radiobeacons are integrity monitored by remote stations for quality of beacon transmission, differential corrections, and GPS positional information. In addition, government agencies concerned with public safety have made it their mandate to ensure that beacon DGPS services are available 24 hours a day, 365 days a year. Performance requirements for marine applications dictate that an availability of 99% or greater is required if a particular system is to be used as a sole means of navigation. The US Coast Guard and Army Corps of Engineers Beacon Network, for example, offer this high level of availability free of charge to all civilian users.

There are other navigation systems in place, in addition to GPS, that merit review. LORAN-C is a ground-based radio navigation system. It operates on a frequency band of 90 kHz to 110 kHz (LF). It has an approximate range of hundreds to thousands of miles, and an accuracy of 0.25 nautical miles repeatable to 18–90 meters, with 95% confidence. Loran-C is a pulsed hyperbolic system that provides 0.25 nm predictable accuracy, 18–90 m repeatable accuracy, 95% confidence and 99.7% availability. Loran-C provides coverage for the continental U.S. and its coastal waters, the Great Lakes, and most of Alaska. Many other countries are also involved in the providing of Loran-C (or Loran-like) services, or are in negotiations with their neighbors to expand coverage. These countries include India, Norway, France. Ireland, Germany, Spain, Italy, Russia, China, Japan, the Philippines and others.

Omega is a low frequency band system with accuracy of 2 to 4 nautical miles with 95% confidence level. Developed by the United States, it is operated in conjunction with six other nations. OMEGA is a very low frequency, phase comparison, worldwide radionavigation system Tacan operates in the U.S. in a frequency band of 960 MHz -1215 MHz (UHF). It has a range of approximately 200 miles at high altitudes. TACAN is primarily used by U.S. and other military aircraft. TACAN radio stations are often co-located with civilian VOR systems allowing military aircraft to operate in civil airspace. The system provides the pilot with relative bearing and distance to the radio beacon.

VOR operates in a frequency band of 108.0 MHz-117.95 MHz (VHF). It has an approximate range of 250 miles, but accuracy as poor as 20 miles. VOR is a beacon-based navigation system operated in the U.S. by the Federal Aviation Administration (FAA) for civil aircraft navigation. When used by itself, the system allows users to determine their azimuth from the VOR station without using any directional equipment. VOR stations are radio beacons that transmit two signals. The first, called the reference signal, is transmitted with constant phase all around the transmitter. The second signal is phase shifted from the first depending on the compass direction of the user from the station. A simple, inexpensive receiver in the aircraft is used to determine the received phase difference of the two signals, and from that information the direction of the aircraft from the transmitter. By using two VOR stations, a specific location may be determined.

Of all the navigation systems mentioned, GPS offers better service, more accuracy, and more serviceable regions than any other approach. There are various classes of GPS service that improve accuracy at higher costs. These include the following categories: (1) Low-cost, single receiver SPS projects (100 meter accuracy); (2) Medium-cost, differential SPS code Positioning (1–10 meter accuracy); (3) High-cost, single receiver PPS projects (20 meter accuracy); (4) High-cost, differential carrier phase surveys (1 mm to 1 cm accuracy); and (5) High-cost, Real-Time-Kinematic (1 cm) with real time accuracy indications.

Referring now to FIG. **1**, a vehicle **10** is illustrated in operation on a roadway, under exposure to radio frequency signals from a variety of sources. These include the GPS satellite system, LORAN or OMEGA radio towers, non-police sources of interference such as restaurant **16**, and police radar signals from a radar gun **18**. In accordance with principles of the present invention, vehicle **10** is equipped with a radar detector able to identify the present coordinates and/or velocity of the vehicle, e.g. using an associated GPS receiver or alternatively a receiver of land-based signals such as LORAN. The radar detector is able to use this information to enhance its decision-making abilities.

Referring now to FIG. **2**, the radar detector **20** in accordance with principles of the present invention includes a fusion processor **22** for controlling all functions of the unit. Fusion processor receives information on radar signals from a conventional microwave receiver **24**, coupled to processor **22** via a digital signal processor (DSP) 26. Microwave receiver **24** and DSP **26** may utilize any of the techniques described above and in the above-referenced patents, for rejecting noise and increasing discrimination between actual and spurious police radar signals. Further, receiver **24** and DSP **26** may be controlled by an optional second CPU **25**, which can enable additional signal evaluation beyond that which is possible using a DSP.

Processor **22** is further connected to a laser detector **28** for detecting police LIDAR signals. Processor **22** is further connected to a GPS receiver **32** and a separate differential GPS (DGPS) receiver **30**, such that differential GPS methodologies may be used where beacon signals are available. Since the radar detector application described in this patent is not a candidate for military class service, it is not able to access the more accurate PPS. However it is considered a "civil user" and can use the SPS without restriction.

Processor **22** executes a stored program, found in an electrically erasable programmable read only memory

(EEPROM) **34**, flash memory, or masked read only memory (ROM). The processor is programmed to manage and report detected signals in various ways depending on its stored program. This programming includes functions for "detector response conditioning," as elaborated below, e.g., with reference to FIGS. **6**A through **6**D.

The radar detector further incorporates a user input keypad or switches **36**. Operational commands are conveyed by the user to processor **22** via the keypad. Processor **22** is further connected to a display **38**, which may comprise one or more light emitting diodes for indicating various status conditions, or in a more feature-rich device, may include an alphanumeric or graphical display for providing detailed information to a user. A speaker **40** is also provided to enable processor **22** to deliver audible feedback to a user under various alert conditions, as is elaborated below.

Processor **22** may further include an interface **44**, such as an ODB II compliant interface, for connection to vehicle electronic systems **42** that are built into the vehicle **10**. Modem vehicles are being equipped with standardized information systems using the so-called OBD **11** standard interface. This standard interface is described in an article entitled ODB II Diagnostics, by Larry Carley, from Import Car, January 1997, which is hereby incorporated herein by reference. Processor **22**, using the OBD II standard interface **44**, can obtain vehicle speed and other vehicle status information directly from the vehicle, and then may use this information appropriately as described in more detail below.

Processor **22** is further coupled to a Universal Serial Bus (USB) interface **46** that provides a means for uploading and downloading information to and from processor **22**. Specifically, USB interface **46** may be used to automate the assimilation of coordinate information into data structures in EEPROM **34**, as described below with reference to FIGS. **3** through **5**. USB interface **46** may also be used to interface the detector to a separate host computer or product application containing a larger storage capacity than available from internal memory. Remote storage devices may include any form of dynamically allocatable storage device (DASD) such as a hard disk drive, removable or fixed magnetic, optical or magneto-optical disk drive, or removable or fixed memory card, or any device including a dynamic directory structure or table of contents included in the storage format to permit dynamic storage allocation. The host computer or other connected device need not be visible to the driver and may be in any convenient location, such as under the vehicle dash.

Coordinate information can be stored, e.g., on a hard drive organized with an indexed database structure to facilitate rapid retrieval, and the hard drive may include a special purpose processor to facilitate rapid retrieval of this information.

Where a general purpose host computer is connected via the USB interface, it will likely be based on a higher scale CPU chip and thus be able to efficiently carry out complex coordinate comparison tasks such as are described below, and such tasks may be delegated to the host CPU rather than carried out in fusion processor **22**. The host CPU can also anticipate the need for information about particular coordinates based upon vehicle movements, and respond by retrieving records within proximity of the current location for ready delivery to fusion processor **22**. The host computer can also provide navigational functions to the driver, potentially using stored signal information and flag bits to provide the user with location-specific information about driving hazards and potential police stakeout locations.

Signal information may also be downloaded from other hosts, for example, a connection may be established directly via the USB interface to an Internet site carrying signal information, as is now done in a text form at the Internet site speedtrap.com. An indirect Internet connection may also be established via a host computer. Furthermore, connections may be established between two receivers, e.g. a trained receiver having extensive signal information, and a receiver having less extensive information, to transfer signal information between the receivers so that either or both has a more complete set of signal information.

Generally speaking, processor **22** compares the radar detector's immediate coordinates with a stored list of the coordinates of unwanted stationary sources. If the radar detector receives a microwave/laser signal within a certain distance of one of these pre-designated sources, processor **22** applies additional constraints to the detection criterion before alerting the user. Since stationary radar sources make up the bulk of the unwanted sources, there is a significant benefit resulting from these functions. Further details on these operations are provided below with reference to FIGS. **6**A through **6**D.

FIG. **3** illustrates data structures **50** stored in EEPROM **34** and used for managing information utilized in accordance with principles of the present invention. As seen in FIG. **3**, these data structures include a plurality of main entries **52**, each including a field **54** for a coordinate, a field **56** for identifying the date and time data was collected, and three fields **58**, **60** and **62** providing information on the source.

Field **54** provides the coordinate of a "cell" of space. As will be elaborated below, coordinates provided by GPS receiver **32** are reduced in resolution to arrive at a "cell" coordinate, which indicates that the current location of the receiver is within a relatively large (e.g., ⅛ or ¼ mile square) block of space on the Earth's surface. This approach reduces the storage requirements for information stored by the radar detector to a manageable level. The sizes of the cells can be variably adjusted based upon the available memory and the desired precision. In the present example, 128 bits are allocated to storing cell coordinates, so the cell coordinates can only have as much precision as can be provided in 128 bits a cell, e.g., by discarding the least significant bits of the coordinates. In other applications, different bit sizes and resolutions could be utilized. It will also be noted that the storage requirements can be reduced by designing the receiver for operation only in a specified part of the Earth, e.g., only in Europe, Japan or North America. By so doing, part of the coordinates for a cell will not need to be stored because they will be the same for all stored cells. In such an embodiment, whenever the coordinates provided by the GPS receiver fall outside of the pre-established region, the receiver will either disable all storage of information (if approved via operational input from the user), or establish a new region of interest and discard all data from previously identified regions. Alternatively, the operator may set the device in either a "precision" (high coordinate resolution) or "wide area" (low coordinate resolution) mode, based upon the driving habits of the driver. In "wide area" mode, the reduced resolution used for each cell coordinate permits a greater number of coordinates to be stored, albeit with reduced precision as to each coordinate. Rural drivers and others that often follow common paths, would be best suited to "precision" mode, whereas urban drivers would be better suited to "wide area" mode. As a further alternative, the detector may automatically select a mode based upon the memory consumption or the time lapse before the memory of the detector becomes full; if the memory fills rapidly, the

unit would automatically switch to a "wide area" mode using low precision coordinates, whereas if the memory never fills or fills only slowly, the unit will remain in its "precision" mode.

The date and time information in field **56** is useful when selecting least recently used (oldest) entries in storage for replacement, as is described further below.

Fields **58**, **60** and **62** store source incidence counters, one for each of a plurality of frequency blocks. Field **58** stores counter(s) for block(s) in the X band. Field **60** stores counter(s) for block(s) in the K band. Field **62** stores counter(s) for block(s) in the Ka band. The number of blocks in each band can vary in different embodiments of the present invention, and is a function of the signal frequency content details provided by the detector **24** and DSP **26**. As one example, the X, K and Ka bands are divided into a total of 32 frequency blocks. Each block is provided a 4-bit counter in fields **58**, **60** and **62**. The counters have a minimum value of 0 and a maximum value of 15and are a measure of the number of times a signal in the associated frequency block has been detected at that location. As will be described below in greater detail, the "source incidence" counters are used in identifying geographic locations that appear to have spurious sources of police radar signals, due to repeated detection of such signals without confirmation of police activity.

In the data structures shown in FIG. **3**, to save space, main entries **52** are interleaved with a greater number of differential entries **64**, each of which stores information for a cell. A first field in a differential entry **64** is an index pointer **66** to a main entry **52**, e.g. an index to a storage location at which the main entry is stored. A second field is a differential field **68** that identifies the difference between the coordinate of the differential entry **64** and the coordinate stored in the main entry **52**. The index and differential can be stored in substantially fewer than 128 bits, so that a differential entry **64** is substantially smaller than a main entry, thus saving storage space. Differential entries further include a date and time field **56** and fields **58**, **60** and **62** for storing counters for X, K or Ka frequencies, as described above.

FIG. **4** illustrates data structures **70** used to store vehicle motion history records or trip records in EEPROM **34**. These data structures include main entries **72** which include field **74** storing a 128 bit cell coordinate, followed by a speed field **76** which can be, for example, 7 bits in length.

Differential entries **78** associated with each main entry include a differential coordinate field **80** indicating the difference in the cell coordinate from the associated main entry **72**, and a speed field **76** indicating a speed recorded at the cell. Because motion history records or trip records are stored sequentially during motion of the detector, differential entries **78** are stored after and adjacent to the associated main entry **72**. Accordingly, differential entries **78** do not require an index field to associate the differential entry **78** with a main entry **72**, because the association is implied from the location of the differential entry **78** in memory after its associated main entry **72**.

History entries may be used for a number of purposes. For example, in the following description, history entries are accessed as part of defining an "everyday route" taken by the detector at the operator's identification. History entries may also be used for driver monitoring; they may be downloaded to a host PC via USB interface **46**, and evaluated to determine whether the vehicle has taken abrupt turns, show excessive speed, or entered undesired locations, all of which may be useful in monitoring the activity, e.g., of teenage drivers. History entries may also be uploaded to PC to provide evidence of the driving history of the vehicle before and at the time of a police citation for speeding. If a driver has been unfairly cited for speeding, history records from the detector can provide compelling evidence to court that the citation is in error. For the purpose of enabling these uses, history entries stored by fusion processor **22** are encrypted when stored and cannot be modified by fusion processor **22** or any PC software supplied for viewing those entries.

FIG. **5** illustrates data structures **82** that can be used to store hazard information and other flag bits related to cells. These data structures **82** include main entries **84** which include a full 128 bit cell coordinate in field **88**, followed by a date and time field **90** and flag bits **92** indicating the hazard or condition associated with the identified location. The differential entries **86** include an index field **94** pointing to one of the main entries, a differential coordinate field **96** indicating the difference in the cell coordinate from the associated main entry **84**, a date and time field **98**, and a set of flag bits **92** indicating the hazard or condition associated with the identified location. The flag bits may identify various hazard conditions. For example, in the specific embodiment described below, there is an "always warn" flag bit that indicates that police activity has previously been confirmed at the location, and therefore the user should be warned of all apparent police radar signals at the location. Further, there is a "location lockout" flag that indicates that broadband sources of spurious police radar signals have been experienced at the location, and therefore in the future warnings of police radar signals should be suppressed at the location. Similarly, a "minimal visual lockout" flag indicates that, due to the unwanted distraction of spurious police radar warnings at a location, only a minimal visual warning should be made of police radar signals identified at the location. The flag bits further include "frequency lockout" bits, one for each frequency block identified by the radar receiver. These bits identify frequencies at the location in which spurious police radar signals have previously been encountered, so that in the future apparent police radar signals at the same frequencies are ignored. The flag bits may also include additional flags to warn of other conditions, such as that there was construction at the identified location, or that some other cause for traffic slowdowns were seen at the identified location, to aid in vehicle navigation.

The information contained in the databases of FIGS. **3** and **5** may be assimilated by the detector through operation, as is described below. Alternatively, this information may be pre-installed in the detector, e.g. via an upload from a host PC via the USB port **46**. There would be substantial benefits to pre-training a detector in this way for a particular geographic area. By pre-training the detector, the driver would not have to enure the audible alerts that would naturally occur before it is trained for each source of spurious police radar signals. In a give area, the ideal training profile would not vary much from one detector to the next, since all detectors should reject the same sources in the same areas. As a result, there are few issues that would have to be resolved in order to transfer training information from one radar detector.

The Internet provides a convenient means for storing and accessing repositories of information. Web sites will be established and devoted to this task. They will provide several convenient types of training information. One will be a training file containing the coordinate information from the online "Speed Trap Registry" at the internet site www.speedtrap.com. This information would be usable to set "always warn" bits at the locales of known speed traps.

A second type of training information would be training files submitted by individuals for use in particular areas, and the third type of information would be aggregate training files created by integrating individually-submitted information into single files organized by region. Aggregate training files would be managed and updated by the web site administrator.

Training files would have low value if they could not be readily used by other detectors. The transferability of training files from one detector to another will depend on the differences in how real world signals are perceived by their embedded processors. In large part, these differences are a direct result of manufacturing and component variations. During the manufacturing process, a detector goes through a set of calibration steps in order to guarantee that the unit meets specifications for Spectral Band Coverage and Sensitivity. These calibration steps reduce the cost of designing the product since lower cost, poorer tolerance components can be used on the assumption that a final manufacturing calibration procedure will eventually compensate for the lower tolerance. Once calibrated, an acceptable product must also be able to perform over a predefined temperature range.

Component tolerance, manufacturing calibration, and operating temperature are key factors that determine how the spectrum of microwave signals are 'viewed' by the embedded Microprocessor or DSP. Radar products convert the spectral band such as X-Band into an array of values that are proportional to the signal energy in consecutive slots or bins of the spectrum. In order for the product to be 'in tolerance' these slot positions must be adjusted so they precisely cover the full range of X, K, and the Ka bands

The calibration procedure is only concerned with guaranteeing that the slots provide adequate coverage of each band. It is less concerned as to whether any one of these slots falls on a precise physical frequency. Therefore the first frequency block in one detector will not necessary be perceived at the same frequency as the first slot in another detector.

If training data is to be shared between various detectors, it will be necessary for supporting software to compensate for these variations. When new pre-trained data is supplied, the detector will undergo an authentication procedure in order to determine the relationships between the pre-train data and its own receiver configuration. This will be based on comparing the frequencies of newly encountered sources to those of the pre-train data at matching coordinates. By comparing the observed frequencies to those in the training set, a "correction profile" will be constructed, that represents the change between the pre-train data and the output of the local microwave receiver. At the end of the authentication procedure, the entire pre-training file will be incorporated into the active train data. During the authentication procedure, the user will be exposed to unconditioned detector responses. This authentication procedure will be substantially shorter than the training period of a virgin detector. Once authentication is complete, the user will receive a notification indicating that the product is switching from authentication over to normal operation. If the training mode is engaged, the authenticated data will continue to be massaged by new driving encounters, as detailed below.

Referring now to FIG. **6**A, operations of the fusion processor **22** to carry out principles of the present invention can be described in greater detail. Fusion processor **22** performs a main loop of steps during regular operation of GPS enabled radar detection. This main loop of steps is illustrated in FIG. **6**A and is detailed in FIGS. **6**B through **6**F.

When fusion processor **22** is initialized, i.e., when power to the GPS enabled radar detector is turned on, the device is initialized in step **100**. This initialization step includes performing diagnostic checks on the various circuitry illustrated in FIG. **2** to insure its proper operation, as well as initialization of the GPS receiver **32** to insure GPS signals can be received accurately by fusion processor **22**. In addition, various internal variables, such as a variable for identifying a current position, are initialized. The initial values are chosen to insure proper operation; for example, the current position variable is initialized to a value that will cause the first pass through the main loop FIG. **6**A to include processing of a current location in steps **110** and **112** in accordance with FIGS. **6**B–**6**E, as discussed below.

The first step in the main loop performed by fusion processor **22**, is step **102**, in which radar detection circuitry **24** and **26** is accessed to obtain information on police radar signals currently being received by the GPS enabled radar detector. In a subsequent step **104**, fusion processor **22** communicates with GPS receiver **32** to request a current location and a current vehicle speed from the GPS receiver **32**. This information can then be utilized in performing GPS related operations described in the following steps. As noted above, vehicle speed may also be obtained from the vehicle itself via an OBDII interface **44** if the vehicle in which the GPS enabled radar detector is installed has a suitable OBD connector for delivering vehicle speed information. It will be appreciated further that vehicle location information might also be obtained via an OBDII connector from a GPS receiver that may be built into the vehicle within which the GPS enabled radar detector is installed. When the vehicle in which the GPS enabled radar detector is installed has both vehicle speed and vehicle position information available via an OBDII connector, the GPS receiver **32** may not be used at all, or may not even be included in the GPS enabled radar detector, to facilitate cost reduction for the GPS enabled radar detector.

Following steps **102** and **104** in which current police radar and GPS related information is obtained, different actions are taken based upon whether GPS information is available. Specifically, in step **106** it is determined whether a GPS signal has been received. If a GPS signal is available, then all GPS enhanced functions of the radar detector may be performed. If no GPS signal has been received, then the radar detector will revert to processing police radar signals at a manner analogous to conventional non-GPS enabled radar detectors.

Assuming for the moment that a GPS signal is available in step **106**, and therefore a current position for the vehicle is known, then in step **108** a sequence of steps is preformed to process the GPS signal, as is further detailed below with reference to FIGS. **6**B, **6**C and **6**D. This processing can include retrieval and/or updating of stored police radar information and the signal information database illustrated in FIG. **3**, the vehicle history database illustrated in FIG. **4**, and/or the flag database illustrated in FIG. **5**.

After processing the GPS signal, in step **110** keypad activity on keypad **36** is detected and processed to alter operating modes of the GPS enabled radar detector, as described below in further detail with reference to FIG. **6**E. The operative modes controllable through the keypad include:

a "warning suppression" mode in which warnings, particularly audible warnings, produced by the GPS enabled radar detector are suppressed so that they are not disturbing to the operator of the vehicle.

- an "expert meter" mode in which detailed information regarding received warning signals are displayed on display **38** of the GPS enabled radar detector, as described in U.S. Pat. 5,668,554, which is hereby incorporated by reference herein in its entirety.
- a "data overwrite" mode in which the GPS enabled radar detector saves, into the signal information database of FIG. **3**, data regarding any location not previously stored in the database, even when this signal information database is full, by overwriting the oldest data in the signal information database when necessary. When the "data overwrite" mode is disabled, then the signal information database will not be overwritten once it becomes full.
- a "frequency lockout" mode, in which police radar frequencies detected by the receiver are taken to be from non-police sources, and appropriate flags are set in the flag database illustrated in FIG. **5**. The "frequency lockout" mode is engaged by the vehicle operator when non-police radar signals are being received and the operator wishes to suppress future warning signals caused by the same sources at the same geographic locations. As noted below, "frequency lockout" mode can only be engaged while the GPS enabled radar detector is detecting an apparent police radar signal and will be automatically disengaged when this signal is no longer being received.
- a "location lockout" mode, in which the flag database of FIG. **5** is updated to suppress all audible warnings of radar signals at the current location of the vehicle. As is the case with the "frequency lockout" mode, the "location lockout" mode will be enabled by a vehicle operator when the vehicle is near to a known source of spurious police radar signals of a broadband character. The "location lockout" mode can only be engaged while the GPS enabled radar detector is detecting an apparent police radar signal, and will be automatically disengaged whenever a police radar signal is no longer being received from the GPS enabled radar detector.
- a "minimal visual lockout" mode, in which the flag database of FIG. **5** is updated to suppress most or all visual warnings of radar signals at the current location of the vehicle. The "location lockout" mode will be enabled by a vehicle operator when the vehicle is near to a known source of spurious police radar signals of a broadband character, and at that location does not wish to be disturbed by even a visual radar signal warning. The "location lockout" mode can only be engaged while the GPS enabled radar detector is detecting an apparent police radar signal, and will be automatically disengaged whenever a police radar signal is no longer being received from the GPS enabled radar detector.
- a "police confirmation" mode, in which flags in the flag database of FIG. **5** will be set to insure a warning signal is always delivered for any police radar signal received at the current vehicle location. The "police confirmation" mode will be activated by a vehicle operator upon sighting a police stakeout.
- a "training" mode, in which the GPS enabled radar detector will store signal information for all geographic locations that the GPS enabled radar detector reaches or passes during operation. When "training" mode is disabled, the signal incidence counters found in the signal information database of FIG. **3**, will not be modified by the GPS enabled radar detector during its normal operation.
- a "route identification" mode in which the route currently traveled by the vehicle is memorized by the GPS enabled radar detector to be subsequently referenced in performing radar detection. Using "route identification" mode, a user may establish one or more everyday routes traveled by the vehicle, and cause the GPS enabled radar detector to continuously update its signal incidence information in the signal information database of FIG. **3** whenever one of these routes are traversed. Routes are identified by an operator by entering the "route identification" mode at the beginning a route, and then exiting the "route identification" at the end of the route.

After selecting appropriate modes based upon keypad activity, in step **112**, an appropriate audible or visible response is produced by the GPS enabled radar detector based upon it current operating mode and the presence or absence of radar detector signal received in step **102**. Details of this operation are described below with reference to FIG. 6F. After step **112**, processing returns to step **102** to obtain a new radar detector signal output and a new current location and speed and then perform additional analysis of that data as described above.

As noted above, in some circumstances a GPS signal will not be available during operation of the GPS enabled radar detector. In this case, processing continues from step **106** to step **114** in which any non-GPS related operational modes may be activated based upon the activity at keypad **35**. GPS enabled modes are unavailable so long as no GPS signal has been obtained, so the processing in step **114** eliminates those modes which cannot be activated in the absence of a GPS signal. After step **114**, processing continues to step **112** in which an appropriate audible or visible response is generated based upon the current operating mode and the radar detected signal received in step **102**.

Referring now to FIG. **6**B, the processing performed on a GPS signal in step **108** of FIG. **6**A can be described in greater detail. As a first step **120**, GPS coordinates received from the GPS receiver **32** are modified by reducing their accuracy. This process is known as "gridding" the coordinates and involves truncating that part of the coordinate of greater accuracy than the defined grid. As a consequence of this modification, the GPS coordinate is mapped into a cell number; every location on the globe falls within a cell of the grid, and has a particular cell number derived from the most significant bits of the GPS coordinates measured within the cell. Cells may be relatively small, i.e., one-eighth of a mile square, or may be relatively large, i.e., one mile square.

After a current cell number is generated from GPS coordinates, then actions are taken based upon whether the vehicle is transitioning from one cell to another, and further based upon current operational modes of the GPS enabled grid are detected. In the first of these steps **122**, it is determined whether the current cell obtained from the GPS receiver is the same a stored prior cell obtained from the GPS receiver during the previous pass through the processing of FIG. **6**B. If so, the vehicle is in the same cell as has been previously processed, and then no further processing for the current cell is required, and the process of FIG. **6**B returns.

If, however, the vehicle has moved to a new cell, then in step **124**, the cell number for this new current cell is stored as the prior cell, so that in subsequent passes through the process of FIG. **6**B, it will be known whether or not the vehicle has moved to another cell.

After step **124**, steps are taken to manage "everyday route" modes of the GPS enabled radar detector. As noted

above, the user of the GPS enabled radar detector may establish one or more everyday routes traveled by the vehicle and cause the GPS enabled radar detector to, along those routes, continuously update its signal incidence information in the signal information database of FIG. **3**. Accordingly, when the GPS enabled radar detector detects that it is following one of these everyday routes, then it will automatically enter its everyday route mode, and subsequently perform different processing (as further described below in connection with FIGS. **6**C and **6**D). As seen in FIG. **6**B, each time the GPS enabled radar detector determines in step **122** that it has passed from one cell to another, then (a.) if the detector has been following an everyday route, an evaluation is made whether the GPS enabled radar detector is continuing to follow the previously defined everyday route, or (b.) if the detector has not been following an everyday route, a determination is made whether the GPS enabled radar detector has started following a previously defined everyday route.

In the first step of this process, in step **126** it is determined whether the GPS enabled radar detector is already in its "everyday route" mode. If the radar detector is not currently not in its "everyday route" mode, then it is determined whether the radar detector is entering an everyday route; specifically, in step **128**, it is determined whether the current cell coordinate is on any of the pre-stored everyday routes. If the current cell is on one of the everyday routes, then the GPS enabled radar detector will determine that the vehicle carrying the detector is beginning or joining one of these pre-stored routes. In such a case, in step **130** the GPS enabled radar detector will enter its "everyday route" mode for the stored route containing the current cell coordinate. If the current coordinate is not on any stored route, step **130** is bypassed.

Returning to step **126**, if the GPS enabled radar detector is already in its "everyday route" mode, then it is determined whether the detector is continuing to follow this route. In this case, processing proceeds from step **126** to step **132** to determine whether the everyday route is being followed. Specifically, in step **132** it is determined whether the current coordinate is on the current everyday route. If not, then in step **134** the GPS enabled radar detector exits it "everyday route" mode, indicating that the vehicle is no longer on the previously stored everyday route. Otherwise, step **134** is bypassed, and the detector remains in its "everyday route" mode.

Following step **134** or immediately following step **130**, additional steps are performed to determine whether and how to update previously stored signal incidence information in the signal information database of FIG. **3**. Processing also proceeds to step **140** from steps **132** or directly from step **128** based upon conditions described above.

In step **140** it is determined whether a radar signal is being received by the GPS enabled radar detector. If so, then in step **142** the procedure described below with reference to FIG. **6**C is performed to update, as needed, the signal information database of FIG. **3**. If no radar signal is being currently detected, then in step **144** the process described below with reference to FIG. **6**D is performed to update, as needed, the signal information database of FIG. **3**. After step **142** or **144**, in step **146** the history database of FIG. **4** is updated by removing the oldest history entry from that database (if necessary to make room), and creating a new history entry for the current cell. The new history entry will include the cell coordinate or a differential coordinate as discussed above with reference to FIG. **4**, and would also include a vehicle speed as obtained in step **104** from the GPS receiver or alternatively from an OBD II interface to the vehicle. Following step **146**, the processing of the GPS signal is complete.

Referring to FIG. **6**C, updating of the signal information database of FIG. **3** in the presence of a police radar signal can be elaborated. In the first step **150** it is determined whether the GPS enabled radar detector is in its "signal tracking" mode. The "signal tracking" mode is entered whenever the GPS enabled radar detector is receiving an apparent police radar signal as the detector is passing through space. So long as an apparent police radar signal is being continuously detected, the detector will remain in signal tracking mode in order to associate that police radar signal with all of the geographic locations in which it was detected. It will be appreciated that the process of FIG. **6**C will not commence unless there is a police radar signal being detected; therefore, the first step **150** is to determine whether the detector is in its signal tracking mode, and if not, in step **152** to enter the signal tracking mode to thereby begin tracking the police radar signal that had not previously been detected.

After step **152** or after step **150** if the detector is already in its signal tracking mode, in step **154** the current cell coordinate and the frequency data for the current cell is stored in a special tracking storage area accessible to fusion processor **22** in EEPROM **34**. The frequency data and cell information stored in this tracking storage can be used subsequently to identify the source of the tracked police radar signal more accurately.

After step **154**, different actions are taken based upon whether the signal information database of FIG. **3** already contains signal information for the detector's current cell coordinate. If there is no matching cells in the signal information database of FIG. **3**, then processing continues to step **158** in which it is determined whether the signal information database of FIG. **3** is full, i.e., all the storage space allocated to this database in EEPROM **34** has been consumed. If all the space has been consumed, then in step **160** it is determined whether the GPS enabled radar detector is in its "data overwrite" mode. If so, then the user has identified that current information should be stored for each cell encountered by the vehicle, even when doing so requires the elimination of older stored data. Accordingly, in data overwrite mode, processing proceeds from step **160** to step **162** in which the oldest signal and flag entries in the databases of FIGS. **3** and **5** are removed, and then to step **164** in which new signal and flag entries are created for the current cell so that signal information and flag information can be stored. If, however, the detector is not in its "data overwrite" mode in step **160**, then a warning is delivered to the user that storage of information is being prevented due to the database being full (step **166**).

After step **166** or **164**, or immediately after step **156** if there is already data stored for the current cell, in step **168** it is determined whether the GPS enabled radar detector is in its "training" or "everyday route" mode. As noted above, in these modes, signal information stored in the database of FIG. **3** is continuously updated each time a cell is encountered. Accordingly, if the detector is in either its "training" or "everyday route" mode, then in step **170** the unwanted source incidence counter for each frequency block identified by the radar receiver **24** as containing signal, is incremented, preventing an overflow. Subsequently, in step **172** the unwanted source incidence counter for each frequency block identified by the radar receiver **24** as not having signal, is decremented, preventing an underflow. This thus updates the source incidence counters for each frequency block for the

current cell. After this processing, or immediately after step **168** if the GPS enabled radar detector is not in the "training" or "everyday route" mode, updating in step **142** is complete.

Referring now to FIG. **6**D, processing in step **144**, to update various databases when no signal is detected, can be explained. As will be elaborated below, when no police radar signal is being received by the GPS enabled radar detector, this indicates that many of the modes described above for tracking and identifying sources of police radar signal should be terminated.

Specifically, in step **180** it is determined whether the GPS enabled radar detector is in "signal tracking" mode. As discussed above, the "signal tracking" mode signifies that the GPS enabled radar detector is currently tracking the cell locations and frequencies of an apparent police radar signal detected by the GPS enabled radar detector. As discussed above with reference to FIG. **6**C, step **152**, the GPS enabled radar detector will enter "signal tracking" whenever an apparent police radar signal is received. So long as the signal is continuously received, processing of the GPS signal will pass through step **140** of FIG. **6**B to FIG. **6**C, and "signal tracking" mode will remain engaged. If, however, no police radar signal is being received when processing of the GPS signal passes through step **140** of FIG. **6**B, then processing will pass to FIG. **6**D and thus to step **180** of FIG. **6**D. In the first pass through FIG. **6**B after a police radar signal has faded, e.g., due to motion of the vehicle past the source of that signal, "signal tracking" mode will still be engaged as a consequence of prior passes through FIGS. **6**B and **6**C. Thus, if in step **180** of FIG. **6**D, if "signal tracking" mode is engaged, but no police radar signal is currently being received, this indicates that the previously detected signal has just faded. In such a situation, a complete record has been made of the locations in which the source was received by the GPS enabled radar detector. This record can be used to characterize the source as to location and frequency, by analyzing the cells in which the signal was tracked, and the frequencies in which the signal was tracked. Thus, if in step **144**, the GPS enabled radar detector is "signal tracking" mode, in step **182** the detector exits its "signal tracking" mode. Subsequently, steps are taken to store relevant information collected for the tracked signal.

In a first step **184**, it is determined whether the GPS enabled radar detector is in "police confirmation" mode. If so, then the vehicle operator has pressed a key on the keypad of the GPS enabled radar detector indicating that a police stakeout was sighted, during the tracking of apparent police radar signals. In such a case, in step **186** the "always warn" flag bit is set for all or the centralmost cells in the tracked sequence of cells identified while in "signal tracking" mode. Thus, the likely locations of the source of the tracked signal are identified and the flag bits are set so that any apparent police radar signal found in those cells will always cause the user to be warned of police radar.

If the GPS enabled radar detector is not in "police confirmation" mode, in step **188** it is determined whether the GPS enabled radar detector is in "frequency lockout" mode. As described above, the detector will be in "frequency lockout" mode if the vehicle operator has used the keypad to indicate that any apparent police radar signals that were tracked in the preceding and current cell, are from spurious sources, and that the frequencies in which those spurious signals appeared should be ignored in subsequent passes through the same cell location. Accordingly, if the detector is in "frequency lockout" mode in step **188**, processing continues to step **190** in which the lockout bits, in the flag bits **92**, are set for all or central cells of the tracked path taken by the vehicle, for those frequencies that were identified during the "signal tracking" mode.

After step **190**, or immediately after step **188** if the detector is not in "frequency lockout" mode, it is determined whether the receiver is in "location lockout" mode in step **192**. It is noted above, "location lockout" mode is engaged by the vehicle operator when broadband sources of spurious produced radar signals are experienced at a geographic location, and the operator wishes to lockout all frequencies at that location. In such a case, in step **194** all of the frequency lockout bits for all or the centralmost cells in the tracked path of the vehicle are set.

After step **194**, or immediately after step **192** if the detector is not in "location lockout" mode, in step **196** it is determined whether the detector is in "minimal visual" mode. As noted below, the detector will be placed in "minimal visual" mode by the operator when the operator wishes to minimize the indications of police radar signals produced when passing through a geographic region. In such a case, processing continues from step **196** to step **198** in which a minimal visual (MV) flag bit is set in the flag database of FIG. **5** for all or the central most cells in the tracked path of the vehicle.

After step **198**, or immediately after step **196** if the detector is not in "minimal visual" mode, or immediately after step **186** if the GPS enabled radar detector is in "police confirmation" mode, in step **200** it is determined whether the signal information database of FIG. **3** includes data for matching or neighboring cells to those cells in the tracked path of the vehicle. If such a match is found, then in step **202** it is determined whether the detector is in its "training" or "everyday route" mode. If so, then the detector should update the stored signal information for the current cell. Specifically, to update signal information, in step **204** all of the unwanted source incidence counters for frequency blocks identified by the receiver are decremented, preventing underflow.

Following step **204**, or immediately following step **200** if there is no matching signal information or step **202** if the detector is not in its "training" or "everyday route" mode, in step **206** the "frequency lockout", "location lockout", "minimal visual" and "police confirmation" modes are cleared, because the tracking of a police radar signal has ended, and these modes are therefore no longer relevant to the current location of the vehicle.

Referring now to FIG. **6**E, the processing of keypad activity to enter and exit the various modes described throughout can be explained. As noted with reference to FIG. **6**A, various modes are available only if a GPS signal has been obtained from the GPS receiver. If a GPS signal has been obtained then modes are selected from the keypad beginning at step **110**. If a GPS signal has not been obtained then modes are selected from the keypad beginning at step **114**, and a substantial number of modes are disabled and cannot be selected in this circumstance.

The keypad activity to select and deselect a mode may vary based upon the application and style of the GPS enabled radar detector. The display and keypad **38** and **36** may interact to produce a menu system for selecting particular modes and displaying associated information. Alternatively, individual keys of keypad **36** may be utilized to directly activate certain modes. Furthermore, display **38** may include icons or other indicators to identify currently activated modes.

A first collection of modes that may be activated via the keypad **36**, are the "frequency lockout", "location lockout", and "minimal visual lockout" modes. Through interactions

with the keypad in step **210**, the user may initiate or terminate these modes. As described above, when initiated, these modes cause lockout information to be stored into flags of the flag database of FIG. **5** upon termination of tracking an apparent police radar signal. If these modes are not engaged at the time that the police radar signal fades from reception, then no action will be taken to set lockout bits in the flag database of FIG. **5**. This approach permits a vehicle operator to initiate a lockout mode and then cancel the lockout mode, for example if the operator initially believes a radar signal to be spurious, but then determines that it is in fact being generated by a police source. It will also be noted that, by the operations of FIG. **6**D, the "police confirmation" mode will override the "lockout" modes, in that if the "police confirmation" mode is engaged when a police radar signal fades from reception, any "lockout" modes that are engaged will be ignored. The user is not, however, prevented from engaging both modes simultaneously. For example, the user may receive a signal believed to be spurious, and engage a "lockout" mode. The user may then sight a police vehicle and, believing the signal is not spurious, engage "police confirmation" mode. The user may later, however, confirm that the police vehicle is not engaged in a speed trap, and consequently disengage "police confirmation" mode. If the received signal then fades from view, the "lockout" mode will be active and accordingly lockout bits will be set as described above with reference to FIG. **6**D.

In step **212** the vehicle operator may enter or exit the "training mode", which as described above causes the GPS enabled radar detector to collect signal information for all cells that the vehicle traverses.

A third activity that may be undertaken with the keypad, in step **214**, is to request to clear all lockouts for the current vehicle location. This step may be taken where the GPS enabled radar detector has previously been programmed to lockout a frequency or location and subsequently the vehicle operator sights a police source at that location, and wishes to terminate the lockout at that location. When the vehicle operator requests to clear all existing lockouts, in step **216** the grid coordinates of the vehicle location are compared to all existing members of the flag database of FIG. **5**, and all matching and/or neighboring cells are selected and all lockout bits in those cells are cleared.

The vehicle operator may also enter or exit a "warning suppression" mode in step **218**, in which a warning for a currently tracked police radar signal is suppressed, i.e., so that the detector does not continue to issue warning signals for the same radar signal received. An operator may also enter or exit an "expert meter" mode in step **220**, requesting that enhanced information on police radar signals received and/or GPS related lockout information or signal incidence information be displayed on display **38** of the detector. An operator may also enter a "data override" mode in step **222**, thus requesting that signal information for new locations visited by the vehicle not found in the database be stored, even at the expense of overriding the oldest previously stored data of this kind. It is also possible, as shown in FIG. **6**E, that there may be no keypad activity at the time that operation of the detector passes through step **110**. In this circumstance, step **224**, no further processing is performed.

A further action that a vehicle operator may take is to confirm of a police sighting in step **226**. This step causes the detector to enter "police confirmation" mode, so that the detector will ensure that police radar signals at the identified stakeout location is handled with particular urgency. Accordingly, when the user enters a police confirmation in step **226**, then action is taken to set one for more "always warn" flag bits of the flag database of FIG. **5**.

If at the time that the operator presses the police confirmation, no apparent police radar signal is currently being tracked, then in step **228** the receiver will not be in "signal tracking" mode. In such a circumstance, processing will continue from step **228** to step **232** in which the "always warn" flag bit is set for the current and neighboring cells of the current location of the vehicle. This step ensures that in future times when a police radar signal is detected in these locations, a warning will be delivered to the vehicle operator regardless of other conditions applicable at the time. If a signal is being tracked at the time that the vehicle operator enters a police confirmation, then a slightly different activity is undertaken. Specifically, in this case processing continues from step **228** to step **230** in which the "police confirmation" mode is entered. As noted above with respect to FIG. **6**D, once the receiver is in police confirmation mode, upon termination of signal tracking, central or all cells along the tracked path of the vehicle when the police radar signal was detected, will be marked as "always warn" in the flag database of FIG. **5**.

A further activity that may be undertaken by a vehicle operator is to indicate that the vehicle is at the beginning of an everyday route, in step **240**. Doing so causes the GPS enabled radar detector to begin to collect information on the everyday route, for the purpose of ultimately storing a definition of an everyday route to be evaluated in connection with the processing described in connection with FIG. **6**B, step **128**. When the user indicates that the vehicle is at the beginning of an everyday route, in step **242** the current cell coordinate and the current entry in the vehicle history database of FIG. **4** are stored for later reference. Then in step **244** the detector enters a "Route identification" mode, used later in establishing that a route has been identified and is being tracked. When the user wishes to complete an everyday route or wishes to clear everyday route processing for the current vehicle location, the user engages an end or clear operation in step **246**. When this step is taken by the user, an initial determination is made in step **248** whether the detector is currently in its "route identification" mode. If so, then the user has identified the end of the everyday route that was previously identified in step **240**. Thus, in step **250** it is determined whether the history entry identified and marked in step **242** continues to store the location of the route start that was stored in step **242**. If so, then all of the cells accumulated in the vehicle history following the history entry identified in step **242**, describe the route taken by the vehicle along the path selected by the user. In this case, all cells accumulated in the history database of FIG. **4** are copied to a special "everyday route" storage area so that all of these cells are available for analysis in connection with the processing of FIG. **6**B, step **128**. After storing the accumulated history entry cells, in step **252**, processing is completed. After step **252**, in step **253** the "route identification" mode is exited.

If in step **250**, it is determined that the vehicle history database of FIG. **4** is no longer storing the start of the everyday route defined by the user, then the everyday route defined by the user was too lengthy to be processed by the GPS enabled radar detector. In such a situation, in step **254** the stored route start information is cleared and the "route identification" mode is exited.

If in step **248**, the GPS enabled radar detector is not in "route identification" mode at the time that the vehicle operator requests the end of everyday route in step **246**, then the vehicle operator may wish to delete any everyday route that includes or passes through the current cell. Thus, in step **258**, a display is generated to the operator requesting con-

firmation that any everyday route including the current cell should be cleared. If a confirmation is received in step **258**, then in step **260** all everyday routes including the current cell are erased from the everyday route storage of the GPS enabled radar detector. If the vehicle operator does not confirm erasure of everyday route information, then processing completes without erasing any everyday route information.

In step **114** of FIG. **6A**, non GPS modes of the GPS enabled radar detector may be activated utilizing keypad activity. This step may be taken if no GPS signal is available at some point during operation of the GPS enabled radar detector. In such a circumstance, in step **262** all GPS related modes of the GPS enabled radar detector are cleared. These include the frequency location and minimal visual lockout modes, the route identification mode, the police confirmation mode, the training mode and the everyday route mode (step **262**). After clearing these modes, non GPS related modes of the GPS enabled radar detector can be initiated. These modes include the "warning suppression" mode (step **218**), the "expert meter" (step **220**), and the "data override" mode (step **222**). Other modes that the operator may attempt to select will be ignored so long as no GPS signal is being received.

Referring now to FIG. **6F**, operations performed in connection with generating audible and visible responses to police radar signals can be explained. In a first step **270**, it is determined whether any of a number of lockout or other flags in the flag database of FIG. **5** are applicable to the current cell. In this step **270**, the flag database is evaluated to see if there is an entry for the current cell, and if so whether the location lockout, minimal visual lockout or always warn flags in that entry are set. If none of these flags are set, then processing of police radar signals at the current location proceeds based upon information in the signal information database of FIG. **3**, or based upon defaults if there is no previously stored information. Accordingly, if none of the flags identified in step **270** are set, then in step **272** it is determined whether there is a cell match in the signal information database of FIG. **3**. If there is such a cell match, the frequencies identified by the radar receiver are compared to the signal information in the entry in the database of FIG. **3**.

In the first step of this process, the first frequency block identified by the receiver is selected (step **274**). Then, in step **276**, it is determined whether the selected frequency block in the signal information database has a source incidence counter greater than a predetermined "ignore" threshold. If radar signals have been frequently detected in the selected frequency block, but there has never been a police sighting there (and thus the "always warn" flag has never been set), this is strongly indicative of a false source at that location. Accordingly, if the source incidence counter for a frequency block exceeds the "ignore" threshold, then any police radar signals identified in that frequency block are ignored. If, however, the selected frequency block does not have a source incidence counter greater than this threshold, then in step **278** it is determined whether the frequency block has a lockout flag bit set in the flag database of FIG. **5**. Only if the frequency lockout bit for the selected frequency is not set, will processing continue to step **280**. In step **280** it is determined whether the selected frequency block has a source incidence counter greater than a "silent" threshold. If the source incidence counter exceeds this threshold, then it is likely that there is a false source radar signals at the location, and as a result in step **282** a visual-only response is generated for the frequency band including the selected frequency block. If, however, the selected frequency block does not have a source incidence counter greater than the silent threshold, then an audible and visual response can be generated. In step **284** it is determined whether the receiver is in "warning suppression" mode. If not in this mode, then an audible and visual response is generated for the band of signals including the selected frequency block. Visual response may be a normal response or may be an "expert meter" response depending upon the status of the "expert meter" mode of the receiver.

After steps **282** or **284**, or immediately after steps **276** or **278** if a frequency block is to be ignored or has been locked out, in step **285** it is determined whether there are additional frequency blocks to be evaluated. If so, then in step **286** the next frequency block is selected and processing returns to step **276**. After all frequency blocks have been evaluated, processing ends at step **285**, and the generation of audible and visual responses is completed.

Returning to step **270**, if one of the location lockout, minimal visual lockout or always warn flags are set for the current cell, then in step **290** and in step **292** it is determined which of these flags is set. If the "always warn" flag is set for the current cell, then in step **288** an audible and visual response is generated for all frequencies identified by the received, unless suppressed by "warning suppression mode". Step **288** is also performed following step **272** if there is no match for the current cell in the signal information database.

If the "minimal visual" flag is set for a current cell, but the "always warn" flag is not, processing proceeds from step **290** to step **292** and then to step **294** in which a minimal visual response is generated for all frequencies identified by the receiver, such as a small blinking flag on the display of the detector.

If the "always warn" and "minimal visual" flags are not set, but the "location lockout" flag is set for the current cell, then processing continues from step **270** through steps **290** and **292** to step **296**, in which a visual-only response is generated for all frequencies identified by the receiver, which may include expert meter information or other details available from the detector.

After step **288**, **294** or **296** processing to generate an audible and/or visual response is completed.

While the present invention has been illustrated by a description of various embodiments and while these embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art.

For example, it will be appreciated that principles of the present invention may also be applied to systems that do not include a GPS receiver. For example, in a simplified embodiment of the present invention, the radar warning receiver may automatically enter its "warning suppression" mode based upon the speed of the vehicle. The speed of the vehicle may, of course, be obtained from a GPS receiver, but if a GPS receiver is not available and/or unnecessarily expensive to include in the receiver, the receiver could obtain vehicle speed information directly from the vehicle's on-board information processing system via the ODB II interface discussed above. A threshold speed of 15 MPH could be used as a default, with "warning suppression" mode automatically engaged at speeds below this threshold. This threshold may be user-adjustable, e.g., within a range such as 5 to 50 MPH.

The interface connector used by the receiver may take other forms than the known USB standard. It may use any

computer interface standard (e.g., IEEE 488), or an automotive wiring standard, the J1854. CAN. BH12 and LIN standards, or others.

In a more refined embodiment, a "everyday route" mode could be included, in which the operator can perform "everyday route velocity" training. In this "everyday route velocity" training mode, the vehicle speed at each point along the "everyday route" would be stored along with the cell locations along the route. Subsequently, when the detector determines that it is on a previously defined everyday route, it will enter "warning suppression" mode whenever the vehicle speed is within a tolerance of, or below, the velocity recorded when in "everyday route velocity" training mode. Thus, no warning signals will be generated so long as the vehicle is not traveling faster than the threshold speed identified by the operator during "everyday route velocity" training of the detector.

It will be further appreciated that the "signal tracking" mode described herein may operate upon each frequency band independently, so that the "signal tracking" mode may be engaged for one band while disengaged for others, and so that the fade-out of a tracked signal at one frequency will cause flag bits to be set for that frequency while other frequencies continue to be tracked.

It will be further appreciated that the determination of whether to generate an audible or visual response, or both, may be based on information in addition to the flags applicable to the current cell of the vehicle. For example, the flags in cells recently traversed by the vehicle may also be consulted to determine whether audible or visual signals should be suppressed at a current cell. Thus, for example, if the detector passes through a cell that has been marked for "minimal visual" lockout, warnings will be suppressed for subsequent cells entered by the vehicle while the same signal is being tracked, regardless of whether flag bits in those cells call for a lockout.

The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and method, and illustrative example shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of applicant's general inventive concept.

What is claimed:

1. A police warning receiver comprising:

a receiver section adapted to receive electromagnetic signals indicative of police activity;

an alert section responsive to the receiver section and adapted to provide an alert if a received electromagnetic signal correlates to a police signal; and

a position determining circuit generating a location signal;

wherein the alert section receives the location signal and is adapted to one of alter and not provide the alert if the location signal correlates to a location of a rejectable signal.

2. The police warning receiver of claim **1**, wherein said electromagnetic signals include radar signals in a radar band.

3. The police warning receiver of claim **1**, wherein said electromagnetic signals are carried in the visible or infrared spectrum.

4. The police warning receiver of claim **1**, wherein the alert section further correlates said rejectable signal to said received electromagnetic signal, and alters the alert based upon the result of the correlation.

5. The police warning receiver of claim **1** wherein said rejectable signal is correlated to said received electromagnetic signal by comparing frequencies of said rejectable signal to frequencies of said received signal.

6. The police warning receiver of claim **5** further comprising storage for signal information associated with geographic locations, said signal information identifying rejectable signals at each geographic location.

7. The police warning receiver of claim **6** wherein said storage for signal information includes a signal incidence counter identifying a number of times a signal has been received by said receiver.

8. The police warning receiver of claim **7** wherein said storage for signal information includes a plurality of signal incidence counters, each associated with a frequency block and identifying a number of times a signal within the associated frequency block has been received by said receiver.

9. The police warning receiver of claim **8** wherein frequencies of said received signal are compared to frequencies in said signal information database to identify frequencies of said received signal having low valued signal incidence counters.

10. The police warning receiver of claim **9** wherein, upon identification of a frequency of said received signal having a low valued signal incidence counter in said signal information database, an alert signal is provided.

11. The police warning receiver of claim **1** further comprising storage for flags associated with geographic locations, said flags identifying rejectable signals at each geographic location.

12. The police warning receiver of claim **11** wherein

said flags include a flag associated with each of a plurality of frequencies identified by said receiver, and indicating whether received signals of the associated frequency are rejectable; and

said received electromagnetic signal is correlated to rejectable signals by comparing frequencies of said received signal to rejectable signal frequencies identified by said flags.

13. The police warning receiver of claim **11** wherein

said flags include a flag associated with a geographic location indicating that all signals received at said geographic location are rejectable; and

said alert section is adapted to alter or not provide the alert if a flag associated with the location signal indicates that all signals received at said geographic location are rejectable.

14. The police warning receiver of claim **11** wherein

said flags include a flag associated with a geographic location indicating that all signals received at said geographic location are rejectable and should be minimally visually identified; and

said alert section is adapted to provide a minimal visual alert if a flag associated with the location signal indicates that all signals received at said geographic location are rejectable and should be minimally identified.

15. The police warning receiver of claim **1** further comprising storage for signal information associated with geographic locations, said signal information identifying rejectable signals at each geographic location.

16. The police warning receiver of claim **15** further comprising an interface connector, wherein signal information is stored in said storage via said interface connector.

17. The police warning receiver of claim **16** wherein said interface connector complies with one of a universal serial bus standard, an automotive wiring standard, the J1854, CAN, BH12 and LIN standards.

18. The police warning receiver of claim **15** wherein said receiver has a training mode in which said signal informa-

tion is modified based upon electromagnetic signals received by the police warning receiver.

19. The police warning receiver of claim **18** wherein

said signal information comprises a signal incidence counter associated with a geographic location,

said signal incidence counter is incremented upon reception of an electromagnetic signal at said geographic location, and

said signal incidence counter is decremented upon failure to receive an electromagnetic signal at said geographic location.

20. The police warning receiver of claim **19** wherein

said signal information comprises a plurality of signal incidence counters each associated with a geographic location and a frequency block,

a signal incidence counter is incremented upon reception of an electromagnetic signal in an associated frequency block at an associated geographic location, and

a signal incidence counter is decremented upon failure to receive an electromagnetic signal in an associated frequency block at an associated geographic location.

21. The police warning receiver of claim **20** wherein

said frequency blocks are associated with frequencies of radar-band electromagnetic signals, and

said signal incidence counters are incremented and decremented upon reception or failure to receive a radar-band electromagnetic signal.

22. The police warning receiver of claim **15** wherein said receiver stores signal information for geographic locations for which no signal information has previously been stored.

23. The police warning receiver of claim **22** wherein said receiver has a data overwrite mode in which signal information is erased to provide room to store signal information for geographic locations for which no signal information has previously been stored, and a mode in which erasure of signal information is prevented.

24. The police warning receiver of claim **1** adapted to access signal information associated with geographic locations, said signal information identifying rejectable signals at each geographic location.

25. The police warning receiver of claim **24** further comprising communication circuitry for obtaining said signal information from an Internet resource.

26. The police warning receiver of claim **24** further comprising communication circuitry for obtaining said signal information from a general purpose computer.

27. The police warning receiver of claim **24** further comprising communication circuitry for obtaining said signal information from another police warning receiver.

28. The police warning receiver of claim **1** further comprising storage for vehicle history information identifying vehicle activities including geographic locations entered by a vehicle carrying said receiver.

29. The police warning receiver of claim **28** wherein said vehicle history information comprises geographic locations entered by a vehicle carrying said receiver and velocities of said vehicle at said locations.

30. The police warning receiver of claim **1** wherein said receiver is responsive to a user input confirming police activity, to identify one or more geographic locations in which electromagnetic signals are not rejectable.

31. The police warning receiver of claim **1** further comprising storage for route information identifying geographic locations relevant to a route traveled by a vehicle carrying said receiver.

32. The police warning receiver of claim **31** further comprising storage for signal information associated with geographic locations of said route, said signal information identifying rejectable signals at each geographic location of said route, wherein said receiver detects transit of said vehicle along said route and in response accesses said signal information to identify rejectable signals.

33. The police warning receiver of claim **32** wherein said receiver modifies said signal information based upon electromagnetic signals received by the police warning receiver while traveling said route.

34. The police warning receiver of claim **33** wherein

said signal information comprises a signal incidence counter associated with a geographic location,

said signal incidence counter is incremented upon reception of an electromagnetic signal at said geographic location, and

said signal incidence counter is decremented upon failure to receive an electromagnetic signal at said geographic location.

35. The police warning receiver of claim **34** wherein

said signal information comprises a plurality of signal incidence counters each associated with a geographic location and a frequency block,

a signal incidence counter is incremented upon reception of an electromagnetic signal in an associated frequency block at an associated geographic location, and

a signal incidence counter is decremented upon failure to receive an electromagnetic signal in an associated frequency block at an associated geographic location.

36. The police warning receiver of claim **1** wherein said receiver tracks geographic locations in which electromagnetic signals are continuously received.

37. The police warning receiver of claim **36** wherein said receiver is responsive to a police confirmation by a user thereof to identify tracked geographic locations in which electromagnetic signals have been continuously received, as not rejectable.

38. The police warning receiver of claim **36** wherein said receiver is responsive to a location lockout by a user thereof to identify tracked geographic locations in which electromagnetic signals have been continuously received, as not rejectable.

39. The police warning receiver of claim **36** wherein said receiver tracks geographic locations in which electromagnetic signals of each of a plurality of frequencies are continuously received.

40. The police warning receiver of claim **39** wherein said receiver is responsive to a frequency lockout by a user thereof to identify tracked geographic locations and frequencies in which electromagnetic signals have been continuously received, as not rejectable.

41. The police warning receiver of claim **1** wherein said receiver has a warning suppression mode in which the alert section is adapted to alter or not provide an alert.

42. The police warning receiver of claim **1** wherein said receiver has an expert meter mode in which the alert section is adapted to display detailed information on said received signal.

43. A police warning receiver comprising:

a receiver section adapted to receive electromagnetic signals indicative of police activity;

an alert section responsive to the receiver section and adapted to provide an alert if a received electromagnetic signal correlates to a police signal; and

a position determining circuit generating a location signal;

storage for vehicle history information identifying vehicle activities including geographic locations entered by a vehicle carrying said receiver.

44. The police warning receiver of claim **43** wherein said vehicle history information comprises geographic locations entered by a vehicle carrying said receiver and velocities of said vehicle at said locations.

45. The police warning receiver of claim **43**, wherein said electromagnetic signals include radar signals in a radar band.

46. The police warning receiver of claim **43**, wherein said electromagnetic signals are carried in the visible or infrared spectrum.

47. The police warning receiver of claim **43** wherein said storage further stores signal information associated with geographic locations, said signal information identifying rejectable signals at geographic locations, said receiver correlating a received electromagnetic signal to rejectable signals at a geographic location corresponding to said location signal, and altering or not providing an alert if the rejectable signals correlate to the received electromagnetic signal.

48. The police warning receiver of claim **43** adapted to access signal information associated with geographic locations, said signal information identifying rejectable signals at each geographic location.

49. The police warning receiver of claim **48** further comprising communication circuitry for obtaining said signal information from an Internet resource.

50. The police warning receiver of claim **48** further comprising communication circuitry for obtaining said signal information from a general purpose computer.

51. The police warning receiver of claim **48** further comprising communication circuitry for obtaining said signal information from another police warning receiver.

52. The police warning receiver of claim **43** further comprising an interface connector,

wherein vehicle history information may be retrieved from said storage via said interface connector.

53. The police warning receiver of claim **52** wherein said interface connector complies with one of a universal serial bus standard, an automotive wiring standard, the J1858, CAN, BH12 and LIN standards.

54. A police warning receiver comprising:

a receiver section adapted to receive electromagnetic signals indicative of police activity;

an alert section responsive to the receiver section and adapted to provide an alert if a received electromagnetic signal correlates to a police signal; and

a dynamically allocatable storage device storing information accessible to said receiver or alert sections, and storing information usable by said receiver or alert sections in receiving or correlating electromagnetic signals.

55. The police warning receiver of claim **54**, wherein said electromagnetic signals include radar signals in a radar band.

56. The police warning receiver of claim **54**, wherein said electromagnetic signals are carried in the visible or infrared spectrum.

57. The police warning receiver of claim **54**, wherein said storage device stores information on rejectable signals, and the alert section further correlates a rejectable signal to said received electromagnetic signal, and alters the alert based upon the result of the correlation.

58. The police warning receiver of claim **54** wherein said rejectable signal is correlated to said received electromagnetic signal by comparing frequencies of said rejectable signal to frequencies of said received signal.

59. The police warning receiver of claim **58**

further comprising a position determining circuit generating a location signal,

wherein said storage device stores signal information associated with geographic locations, said signal information identifying rejectable signals at each geographic location, and

wherein said alert section correlates a rejectable signal for a location corresponding to said location signal, to said received electromagnetic signal, and alters the alert based upon the result of the correlation.

60. The police warning receiver of claim **59** adapted to access and store said signal information associated with geographic locations from external sources.

61. The police warning receiver of claim **60** further comprising communication circuitry for obtaining said signal information from an Internet resource.

62. The police warning receiver of claim **60** further comprising communication circuitry for obtaining said signal information from a general purpose computer.

63. The police warning receiver of claim **60** further comprising communication circuitry for obtaining said signal information from another police warning receiver.

64. The police warning receiver of claim **54** wherein said mass storage device stores vehicle history information identifying vehicle activities including velocities of a vehicle carrying said receiver.

65. The police warning receiver of claim **64**

further comprising a position determining circuit generating a location signal,

wherein said vehicle history information comprises geographic locations entered by a vehicle carrying said receiver and velocities of said vehicle at said locations.

66. The police warning receiver of claim **54** further comprising an interface connector,

wherein information is stored in said storage device via said interface connector.

67. The police warning receiver of claim **66** wherein said interface connector complies with one of a universal serial bus standard, an automotive wiring standard, the J1862, CAN, BH12 and LIN standards.

68. A police warning receiver comprising:

a receiver section adapted to receive electromagnetic signals indicative of police activity;

an alert section responsive to the receiver section and adapted to provide an alert if a received electromagnetic signal correlates to a police signal;

a display for displaying information to a user;

a position determining circuit generating a location signal; and

storage for information relating to prior encounters of electromagnetic signals by the police warning receiver at geographic locations, said information including characterizations of previously encountered electromagnetic signals;

wherein information presented on said display is derived from information relating to a prior encounter of an electromagnetic signal at a geographic location corresponding to the location signal.

69. The police warning receiver of claim **68**, wherein said electromagnetic signals include radar signals in a radar band.

70. The police warning receiver of claim **68**, wherein said electromagnetic signals are carried in the visible or infrared spectrum.

71. The police warning receiver of claim **68**, wherein the alert section correlates information relating to a prior encounter of an electromagnetic signal to said received electromagnetic signal, and alters the alert based upon the result of the correlation.

72. The police warning receiver of claim **68** wherein said information relating to prior encounters of electromagnetic signals comprises signal information identifying signals received at each geographic location.

73. The police warning receiver of claim **72** wherein said signal information includes a signal incidence counter identifying a number of times a signal has been received by said receiver at each geographic location.

74. The police warning receiver of claim **68** wherein said information relating to prior encounters of electromagnetic signals comprises flags associated with geographic locations, said flags identifying rejectable signals at each geographic location.

75. The police warning receiver of claim **68** further comprising an interface connector,

wherein information relating to prior encounters of electromagnetic signals is stored in said storage via said interface connector.

76. The police warning receiver of claim **75** wherein said interface connector complies with one of a universal serial bus standard, an automotive wiring standard, the J1862, CAN, BH12 and LIN standards.

77. The police warning receiver of claim **68** adapted to access and store said information relating to prior encounters from external sources.

78. The police warning receiver of claim **77** further comprising communication circuitry for obtaining said signal information from an Internet resource.

79. The police warning receiver of claim **77** further comprising communication circuitry for obtaining said signal information from a general purpose computer.

80. The police warning receiver of claim **77** further comprising communication circuitry for obtaining said signal information from another police warning receiver.

81. A police warning receiver comprising:

a receiver section adapted to receive electromagnetic signals indicative of police activity;

an alert section responsive to the receiver section and adapted to provide an alert if a received electromagnetic signal correlates to a police signal; and

a digital interface connector,

wherein said police warning receiver is configurable in response to digital signals received via said digital interface connector.

82. The police warning receiver of claim **81**, wherein said electromagnetic signals include radar signals in a radar band.

83. The police warning receiver of claim **81**, wherein said electromagnetic signals are carried in the visible or infrared spectrum.

84. The police warning receiver of claim **81** wherein said interface connector complies with one of a universal serial bus standard, an automotive wiring standard, the J1866, CAN, BH12 and LIN standards.

85. The police warning receiver of claim **81** wherein said interface connector is connectable to a digital computer for configuration of said receiver.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,670,905 B1 Page 1 of 4
DATED : December 30, 2003
INVENTOR(S) : Steven K. Orr

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1,
Line 24, reads "...police radar are generally know as the X, K, and Ka…" and should read -- ...police radar are generally known as the X, K, and Ka… --.
Line 40, reads "...components in the X, K, and very broad Ka band. In…" and should read -- ...components in the X, K, and very braod Ka bands. In… --.

Column 2,
Lines 19-20 read "...systems are vertically polarized, vs circular polarization…" and should read -- ...systems are vertically polarized, vs. circular polarization… --.

Column 3,
Line 10, reads "...leak energy in the, X-Band and K-bands and appeared…" and should read -- ...leak energy in the X- and K-bands and appeared… --.
Line 41, reads "...even the most sophisticated modem radar detector." and should read -- ...even the most sophisticated modern radar detector. --.

Column 4,
Line 47, reads " BRIEF DESCRIPTION OF THE DRAWING" and should read -- BRIEF DESCRIPTION OF THE DRAWINGS --.
Line 62, reads "FIG. 3 is an illustration of a database…" and should read -- FIG. 3 is an illustration of a database… --.

Column 5,
Lines 62-63, read "...and "Precise Positioning System" (PPS.). These classes…" and should read -- …and "Precise Positioning System" (PPS). These classes… --.

Column 6,
Line 33, reads "...set of corrdinates are assigned to the position occupied…" and should read -- ...set of coordinates is assigned to the position occupied… --.
Line 59, reads "The availability of Beacons for DGPS systems elevate the…" and should read -- The availabilty of Beacons of DGPS systems elevates the… --.
Line 64, reads "The White House has Directed that the…" and should read -- The White House has directed that the… --.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,670,905 B1
DATED : December 30, 2003
INVENTOR(S) : Steven K. Orr

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 7,
Lines 56-57 read "...include India, Norway, France. Ireland, Germany, Spain…" and should read -- ...include India, Norway, France, Ireland, Germany, Spain… --.
Lines 63-64, read "...comparison, worldwide radionavigation system Tacan operates in the U.S. in a…" and should read -- ...comparsion, worldwide radionavigation system. TACAN operates in the U.S. in a… --.

Column 9,
Lines 19-10, read "...into the vehicle 10. Modem vehicles are being equipped…" and should read -- ...into the vehicle 10. Modern vehicles are being equipped … --.
Line 21, reads "...systems using the so-called OBD 11 standard…" and should read -- ...systems using the so-called OBD II standard… --.

Column 11,
Line 20, reads "...and a maximum value of 15and are a…" and should read -- ...and a maximum value of 15, and are a … --.

Column 12,
Line 52, reads "...not have to ensure the audible alerts that would naturally…" and should read -- … not have to endure the audible alerts that would naturally…" and should read -- … not have to endure the audible alerts that would naturally… --

Column 13,
Line 32, reads "...the full range of the X, K, and the Ka bands" and should read -- … the full range of the X, K, and the Ka bands. --.

Column 14,
Lines 46-47 read "...police radar signals at a manner analogous to…" and should read -- … police radar signals in a manner analogous to… --.
Lines 51-52, read "...a sequence of steps is preformed to process the GPS…" and should read -- ...a sequence of steps is performed to process the GPS… --.

Column 16,
Line 17, reads "...based upon it current operating mode…" and should read -- ...based upon its current operating mode … --.
Lines 52-53, read "...based upon current operational modes of the GPS enabled grid are detected." and should read -- ...based upon current operational modes of the GPS enabled radar detector. --.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,670,905 B1 Page 3 of 4
DATED : December 30, 2003
INVENTOR(S) : Steven K. Orr

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 16, (cont'd),
Line 55, reads "...receiver is the same a stored prior cell obtained from the…" and should read -- ...receiver is the same stored prior cell obtained from the… --.

Column 17,
Lines 22-23, read "If the radar detector is not currently not in its "everday route" mode …" and should read -- If the radar detector is not currently in its "everday route" mode.. --.
Line 42, read "...134 the GPS enabled radar detector exits it "everyday…" and should read -- ...134 the GPS enabled radar detector exits its "everday … --.

Column 18,
Lines 23-25, read "...154 the current cell coordinate and the frequency data for the current cell is stored in a special tracking…" and should read -- … 154 the current cell coordinate and the frequency data for the current cell are stored in a special tracking … --.
Line 33, reads "… coordinate. If there is no matching cells in the signal… --. and shall read -- … coordinate. If there are no matching cells in the signal… --.

Column 19,
Line 30, reads "Thus, if in step 180 of FIG.6D, if "signal tracking" mode is…" and should read -- Thus, in step 180 of FIG.6D, if "signal tracking" mode is… --.
Lines 39-40, read "...the GPS enabled radar detector is "signal tracking" mode, in step 182 the detector…" and should read -- ...the GPS enabled radar detector is in "signal tracking" mode, in step 182 the detector… --.

Column 20,
Line 22, reads "...database of FIG. 5 for all the central most cells in the…" and should read -- ...database of FIG. 5 for all or the centralmost cells in the… --.

Column 21,
Lines 60-61, read "...operator may take is to confirm of a police sighting in step 226." and should read -- ...operator may take is to confirm a police sighting in step 226. --.
Lines 63-64, read "...detector will ensure the police radar signals at the identified stakeout location is handled with particular urgency." and should read -- ...detector will ensure the police radar signals at the identified stakeout location are handled with particular urgency. --.
Lines 66-67, read "… step 226, then action is taken to set one for more "always warn" flag bits of the flag…" and should read -- … step 226, then action is taken to set one or more "always warn" flag bits of the flag… --.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,670,905 B1 Page 4 of 4
DATED : December 30, 2003
INVENTOR(S) : Steven K. Orr

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 22,
Line 32, reads "...224 the detector enters a "Route identification"mode, used…" and should read -- ...224 the detector enters a "route identification" mode, used… --.

Column 23,
Line 9, reads "In step 114 of FIG. 6A, non GPS modes of the GPS" should read -- In step 114 of FIG. 6A, nonGPS modes of the GPS --.
Line 18, reads "…(step 226). After clearing these modes, non GPS related…" and should read -- …(step 226). After clearing these modes, nonGPS related… --.
Line 65, reads "...is likely that there is a false source radar signals at the…" and should read -- ...is likely that there is a false source of radar signals at the… --.

Column 24,
Lines 18-19, read "… step 270, if one of the location lookout, minimal visual lockout or always warn flags are set for the…"and should read -- … step 270, if one of the location lockout, minimal visual lockout or always warn flags is set for the… --.
Lines 23-24, read "...generated for all frequencies identified by the received, unless suppressed by…" and should read -- ...generated for all frequencies identified by the receiver, unless suppressed by… --.
Line 46, reads "...is not the intention of the applicants to restrict or in any way…" and should read -- ...is not the intention of the applicant to restrict or in any way… --.

Column 25,
Line 2, reads "...motive wiring standard, the J1854. CAN. BH12 and LIN…" and should read -- ...motive wiring standard, the J1854, Can, BH12 and LIN… --.

Signed and Sealed this

Thirty-first Day of May, 2005

JON W. DUDAS
Director of the United States Patent and Trademark Office

EXHIBIT 6

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(12) Patent Application Publication
Orr
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(43) Pub. Date: Nov. 27, 2003

(54) RADAR WARNING RECEIVER WITH POSITION AND VELOCITY SENSITIVE FUNCTIONS

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(21) Appl. No.: **10/396,881**

(22) Filed: **Mar. 25, 2003**

Related U.S. Application Data

(62) Division of application No. 09/889,656, filed on Mar. 15, 2002, filed as 371 of international application No. PCT/US00/16410, filed on Jun. 14, 2000.

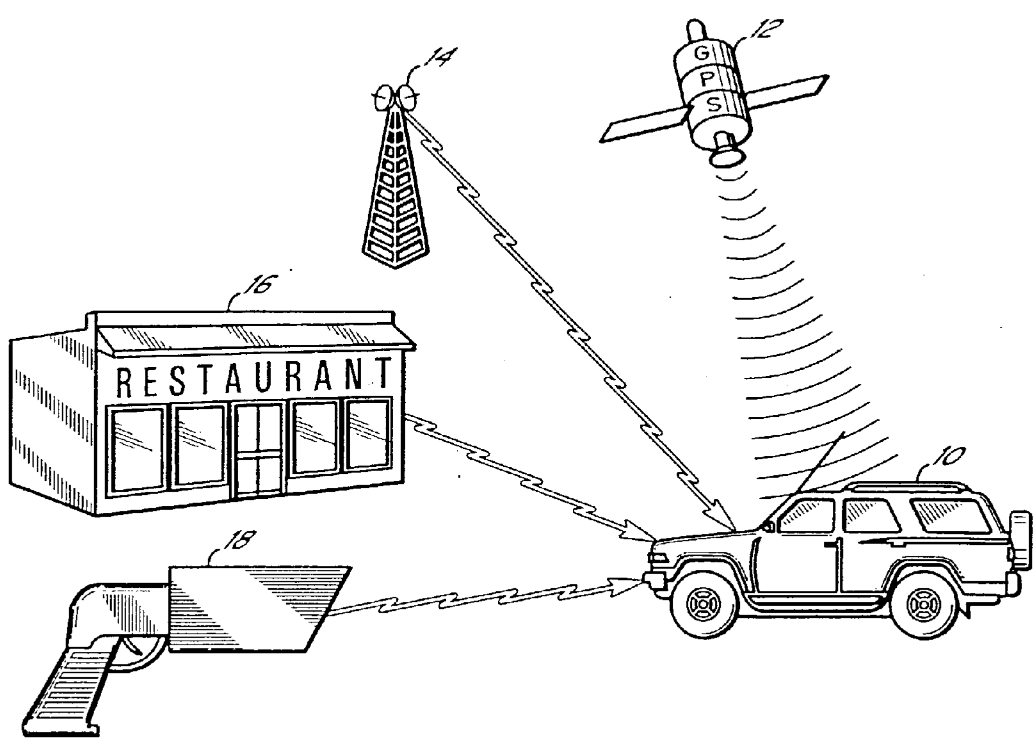
(60) Provisional application No. 60/139,097, filed on Jun. 14, 1999. Provisional application No. 60/145,394, filed on Jul. 23, 1999.

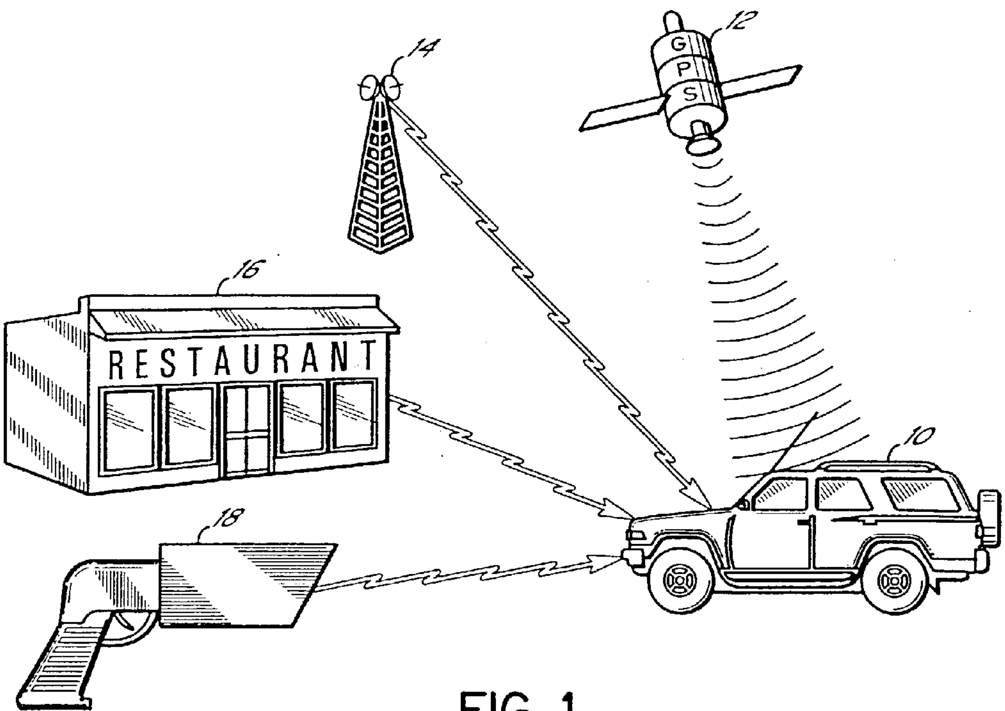
Publication Classification

(51) **Int. Cl.**[7] **G01S 7/40**
(52) **U.S. Cl.** **342/20**

(57) **ABSTRACT**

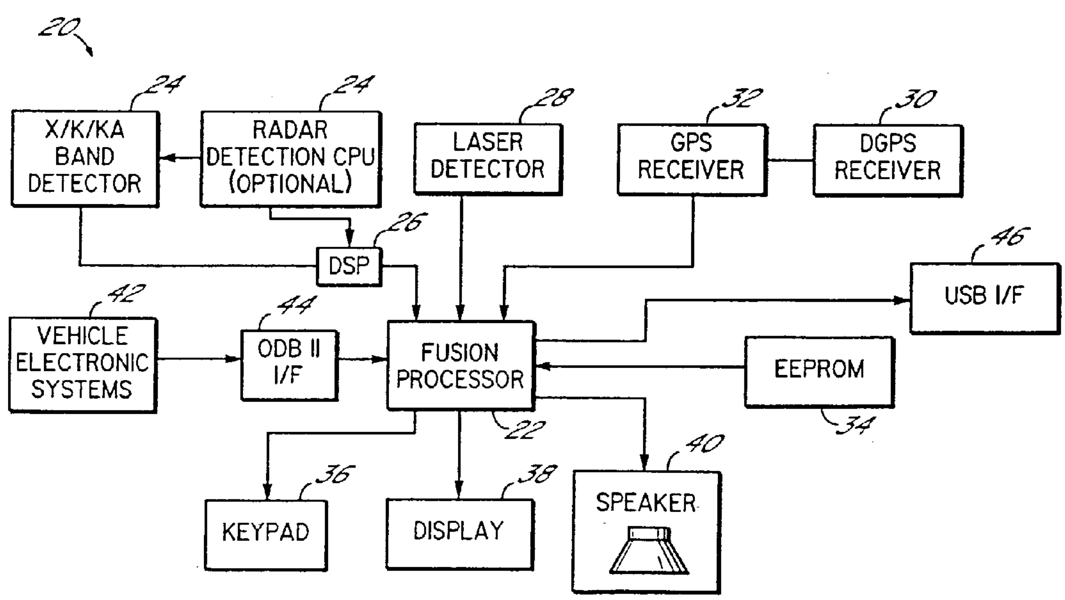
A GPS enabled radar detector (**20**) that aids in the management of unrelated or otherwise unimportant sources (**16**), permitting the detector to dynamically improve its handling of such sources based upon previously-stored geographically-referenced information on such sources. The detector includes technology (**30, 32**) for determining the location of the detector, and comparing this location to the locations of known stationary sources, to improve the handling of such detections. The detector may ignore detections received in an area known to contain a stationary source, or may only ignore specific frequencies or may handle frequencies differently based upon historic trends of spurious police radar signals at each frequency. A Global Positioning Satellite System (GPS) receiver (**30, 32**) is used to establish current physical coordinates. The detector maintains a list (**50, 82**) of the coordinates of the known stationary source "offenders" in nonvolatile memory. Each time a microwave or laser source is detected, it will compare its current coordinates to this list. Notification of the driver will take on a variety of forms depending on the stored information and current operating modes.





14
12
G
P
S
16
RESTAURANT
10
18

FIG. 1



20
24
X/K/KA BAND DETECTOR
24
RADAR DETECTION CPU (OPTIONAL)
28
LASER DETECTOR
32
GPS RECEIVER
30
DGPS RECEIVER
26
DSP
46
USB I/F
42
VEHICLE ELECTRONIC SYSTEMS
44
ODB II I/F
FUSION PROCESSOR
22
EEPROM
34
40
36
KEYPAD
38
DISPLAY
SPEAKER

FIG. 2

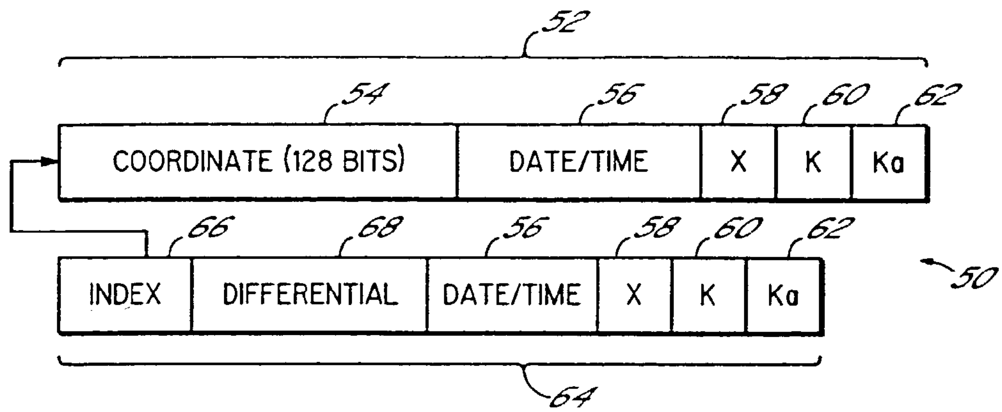


FIG. 3

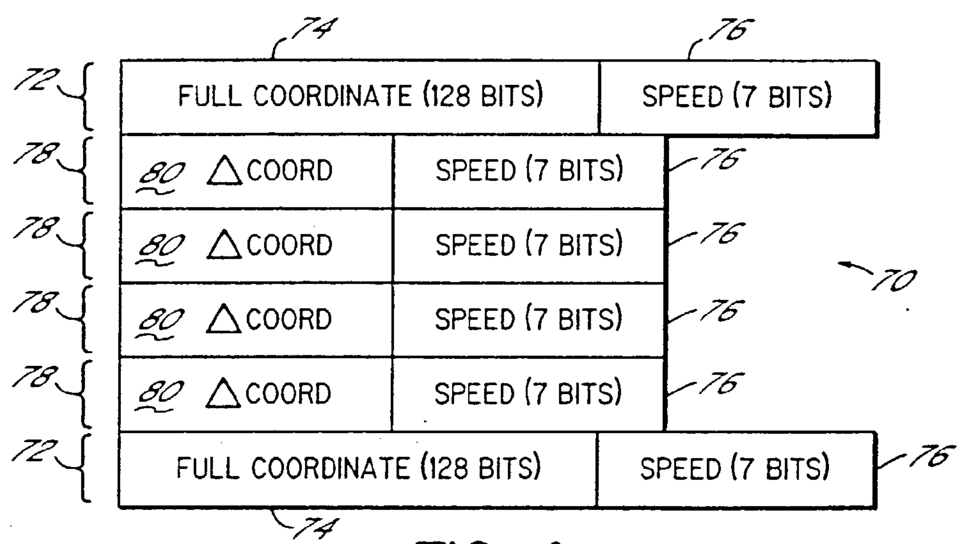


FIG. 4

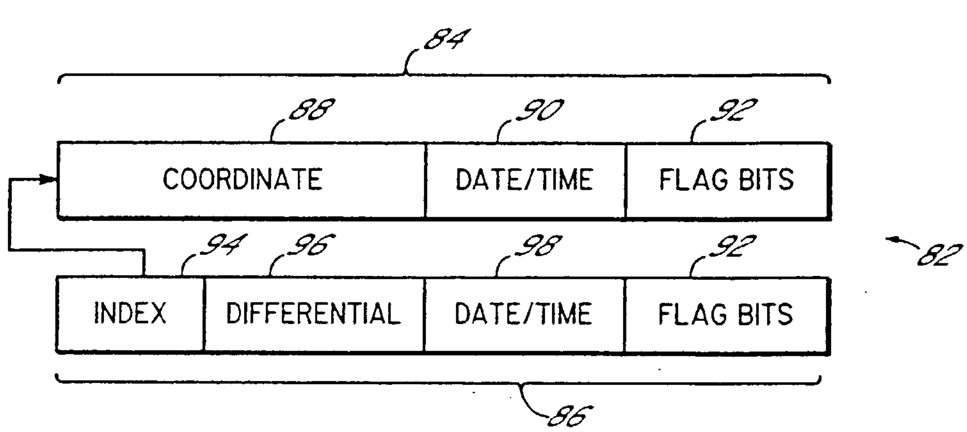


FIG. 5

FIG. 6A

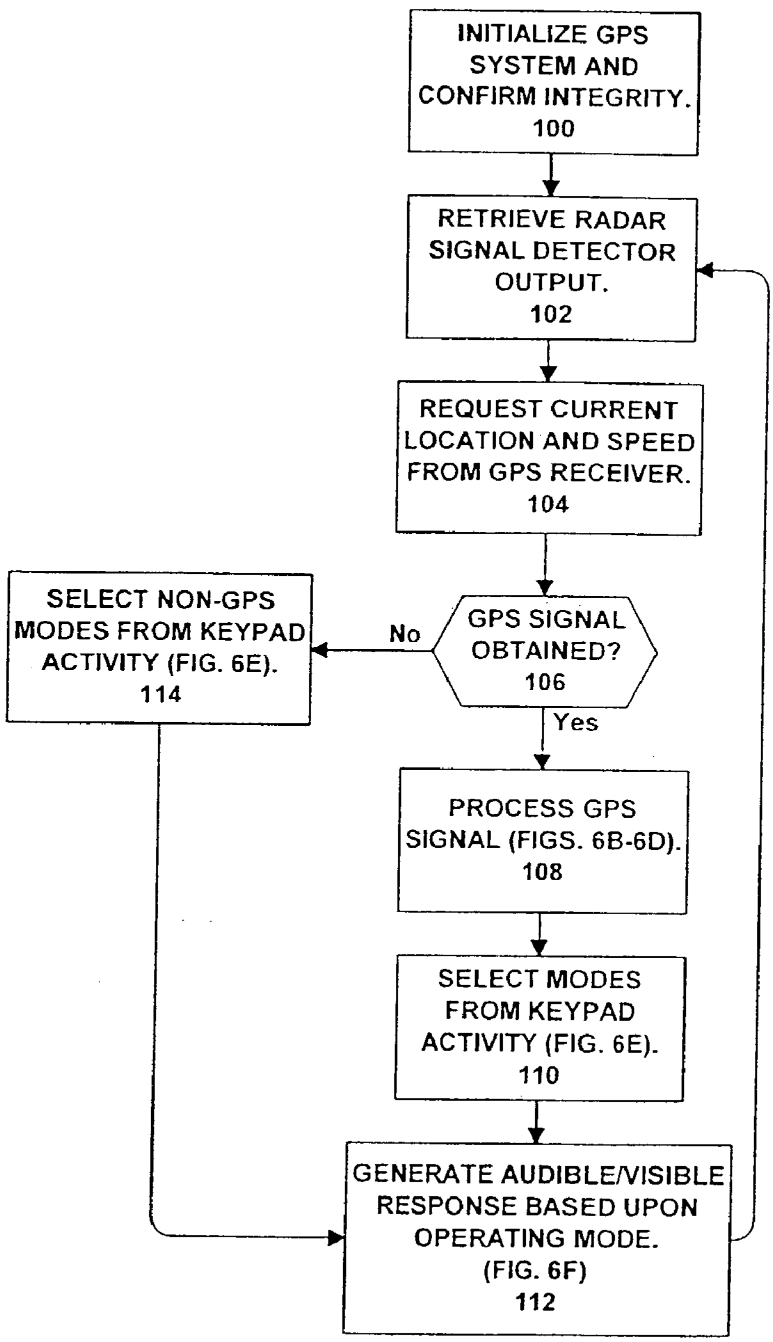

INITIALIZE GPS SYSTEM AND CONFIRM INTEGRITY. 100
RETRIEVE RADAR SIGNAL DETECTOR OUTPUT. 102
REQUEST CURRENT LOCATION AND SPEED FROM GPS RECEIVER. 104
GPS SIGNAL OBTAINED? 106
No
Yes
SELECT NON-GPS MODES FROM KEYPAD ACTIVITY (FIG. 6E). 114
PROCESS GPS SIGNAL (FIGS. 6B-6D). 108
SELECT MODES FROM KEYPAD ACTIVITY (FIG. 6E). 110
GENERATE AUDIBLE/VISIBLE RESPONSE BASED UPON OPERATING MODE. (FIG. 6F) 112

FIG. 6B

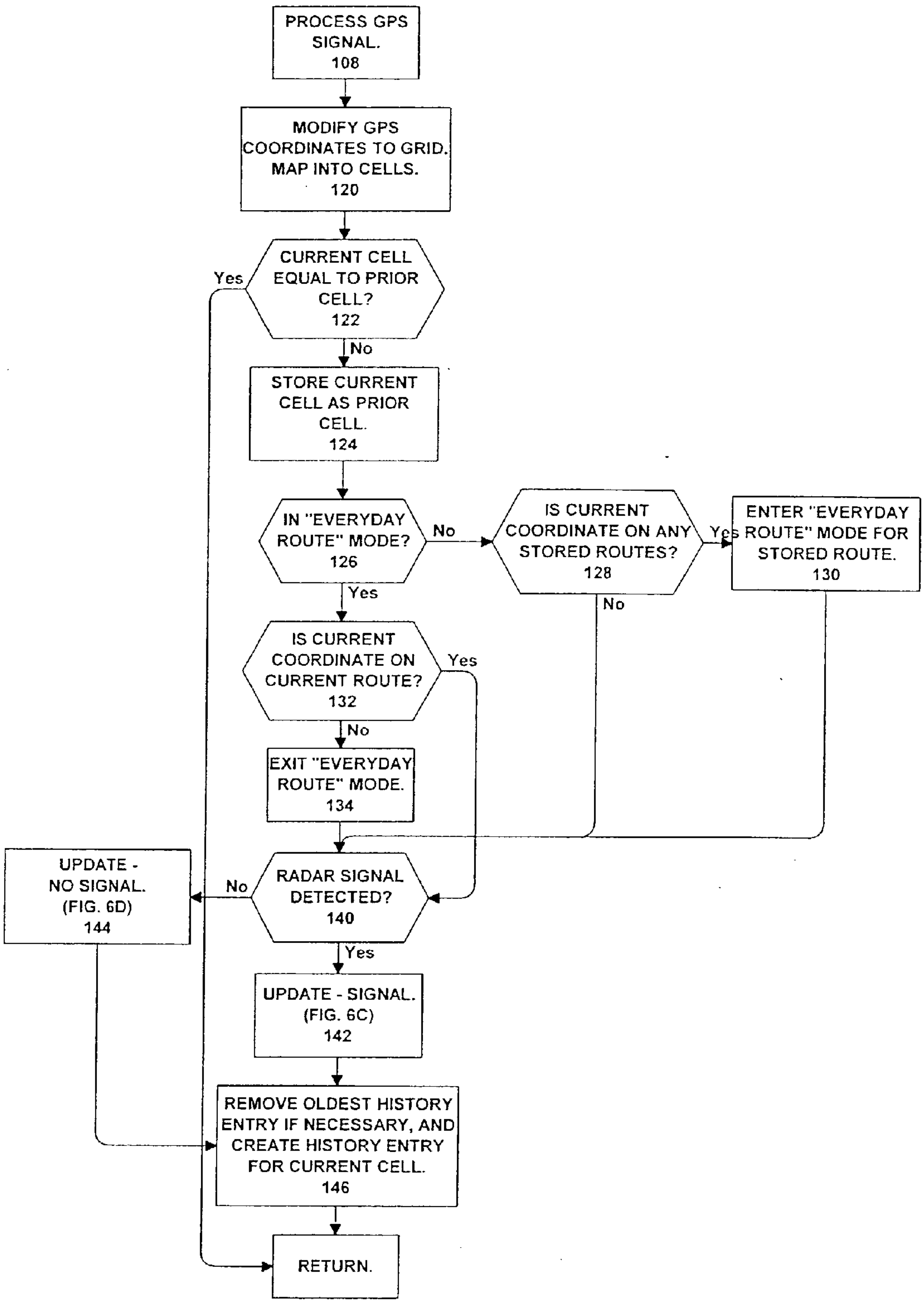

PROCESS GPS SIGNAL. 108
MODIFY GPS COORDINATES TO GRID. MAP INTO CELLS. 120
CURRENT CELL EQUAL TO PRIOR CELL? 122
Yes
No
STORE CURRENT CELL AS PRIOR CELL. 124
IN "EVERYDAY ROUTE" MODE? 126
No
IS CURRENT COORDINATE ON ANY STORED ROUTES? 128
Yes
ENTER "EVERYDAY ROUTE" MODE FOR STORED ROUTE. 130
No
Yes
IS CURRENT COORDINATE ON CURRENT ROUTE? 132
Yes
No
EXIT "EVERYDAY ROUTE" MODE. 134
UPDATE - NO SIGNAL. (FIG. 6D) 144
No
RADAR SIGNAL DETECTED? 140
Yes
UPDATE - SIGNAL. (FIG. 6C) 142
REMOVE OLDEST HISTORY ENTRY IF NECESSARY, AND CREATE HISTORY ENTRY FOR CURRENT CELL. 146
RETURN.

FIG. 6C

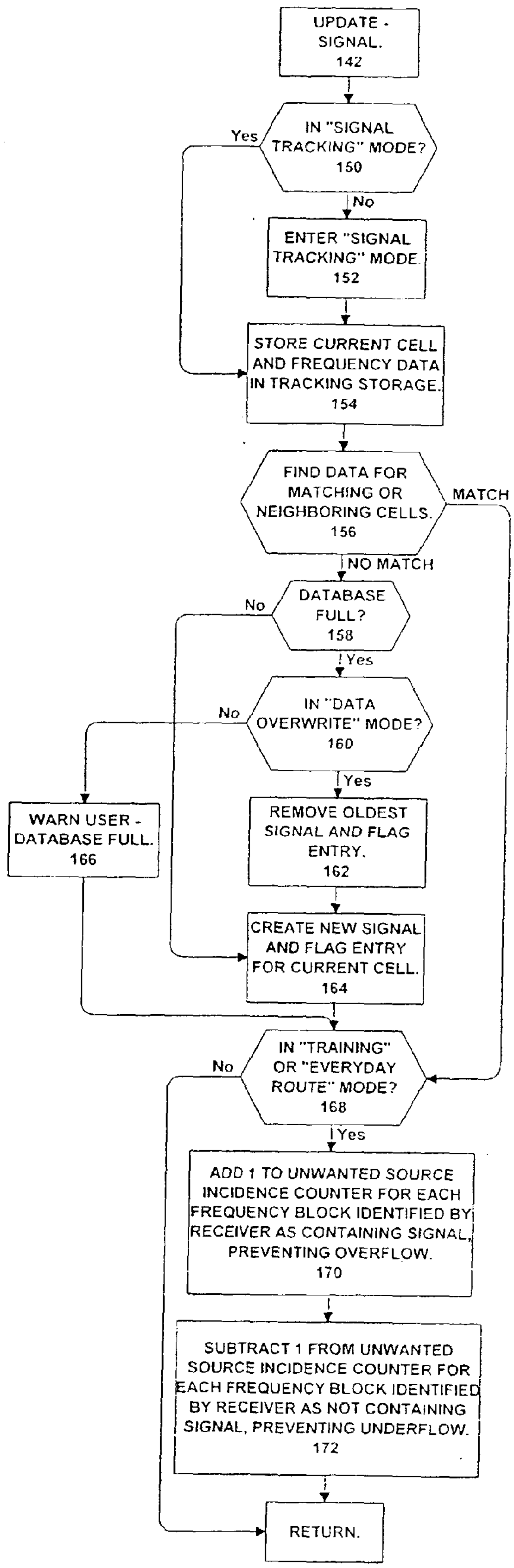
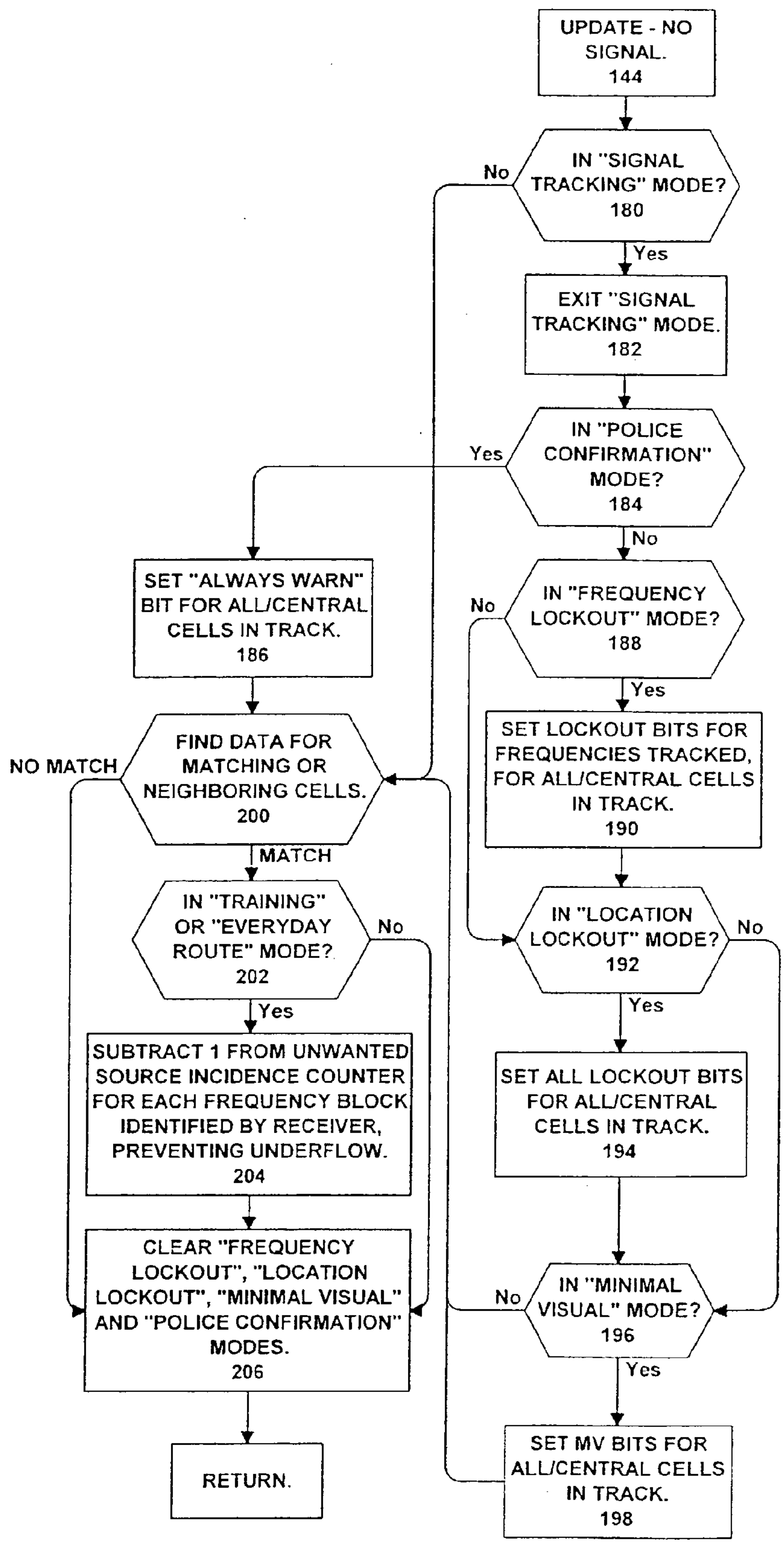

UPDATE - SIGNAL. 142
IN "SIGNAL TRACKING" MODE? 150
Yes
No
ENTER "SIGNAL TRACKING" MODE. 152
STORE CURRENT CELL AND FREQUENCY DATA IN TRACKING STORAGE. 154
FIND DATA FOR MATCHING OR NEIGHBORING CELLS. 156
MATCH
NO MATCH
DATABASE FULL? 158
No
Yes
IN "DATA OVERWRITE" MODE? 160
No
Yes
WARN USER - DATABASE FULL. 166
REMOVE OLDEST SIGNAL AND FLAG ENTRY. 162
CREATE NEW SIGNAL AND FLAG ENTRY FOR CURRENT CELL. 164
IN "TRAINING" OR "EVERYDAY ROUTE" MODE? 168
No
Yes
ADD 1 TO UNWANTED SOURCE INCIDENCE COUNTER FOR EACH FREQUENCY BLOCK IDENTIFIED BY RECEIVER AS CONTAINING SIGNAL, PREVENTING OVERFLOW. 170
SUBTRACT 1 FROM UNWANTED SOURCE INCIDENCE COUNTER FOR EACH FREQUENCY BLOCK IDENTIFIED BY RECEIVER AS NOT CONTAINING SIGNAL, PREVENTING UNDERFLOW. 172
RETURN.

FIG. 6D


UPDATE - NO SIGNAL. 144
IN "SIGNAL TRACKING" MODE? 180
No
Yes
EXIT "SIGNAL TRACKING" MODE. 182
IN "POLICE CONFIRMATION" MODE? 184
Yes
No
SET "ALWAYS WARN" BIT FOR ALL/CENTRAL CELLS IN TRACK. 186
IN "FREQUENCY LOCKOUT" MODE? 188
No
Yes
FIND DATA FOR MATCHING OR NEIGHBORING CELLS. 200
NO MATCH
MATCH
SET LOCKOUT BITS FOR FREQUENCIES TRACKED, FOR ALL/CENTRAL CELLS IN TRACK. 190
IN "TRAINING" OR "EVERYDAY ROUTE" MODE? 202
No
Yes
IN "LOCATION LOCKOUT" MODE? 192
No
Yes
SUBTRACT 1 FROM UNWANTED SOURCE INCIDENCE COUNTER FOR EACH FREQUENCY BLOCK IDENTIFIED BY RECEIVER, PREVENTING UNDERFLOW. 204
SET ALL LOCKOUT BITS FOR ALL/CENTRAL CELLS IN TRACK. 194
CLEAR "FREQUENCY LOCKOUT", "LOCATION LOCKOUT", "MINIMAL VISUAL" AND "POLICE CONFIRMATION" MODES. 206
IN "MINIMAL VISUAL" MODE? 196
No
Yes
RETURN.
SET MV BITS FOR ALL/CENTRAL CELLS IN TRACK. 198

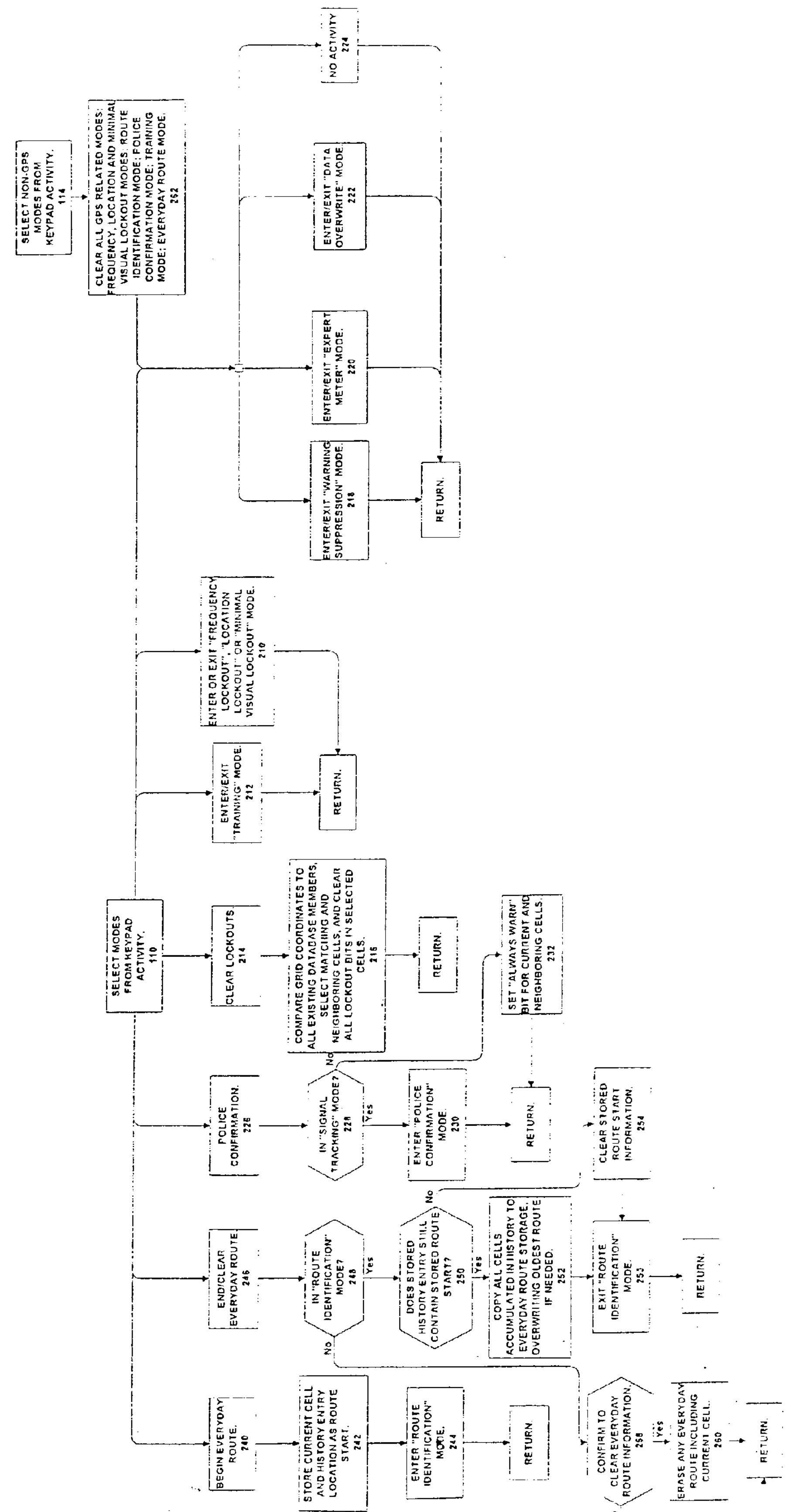
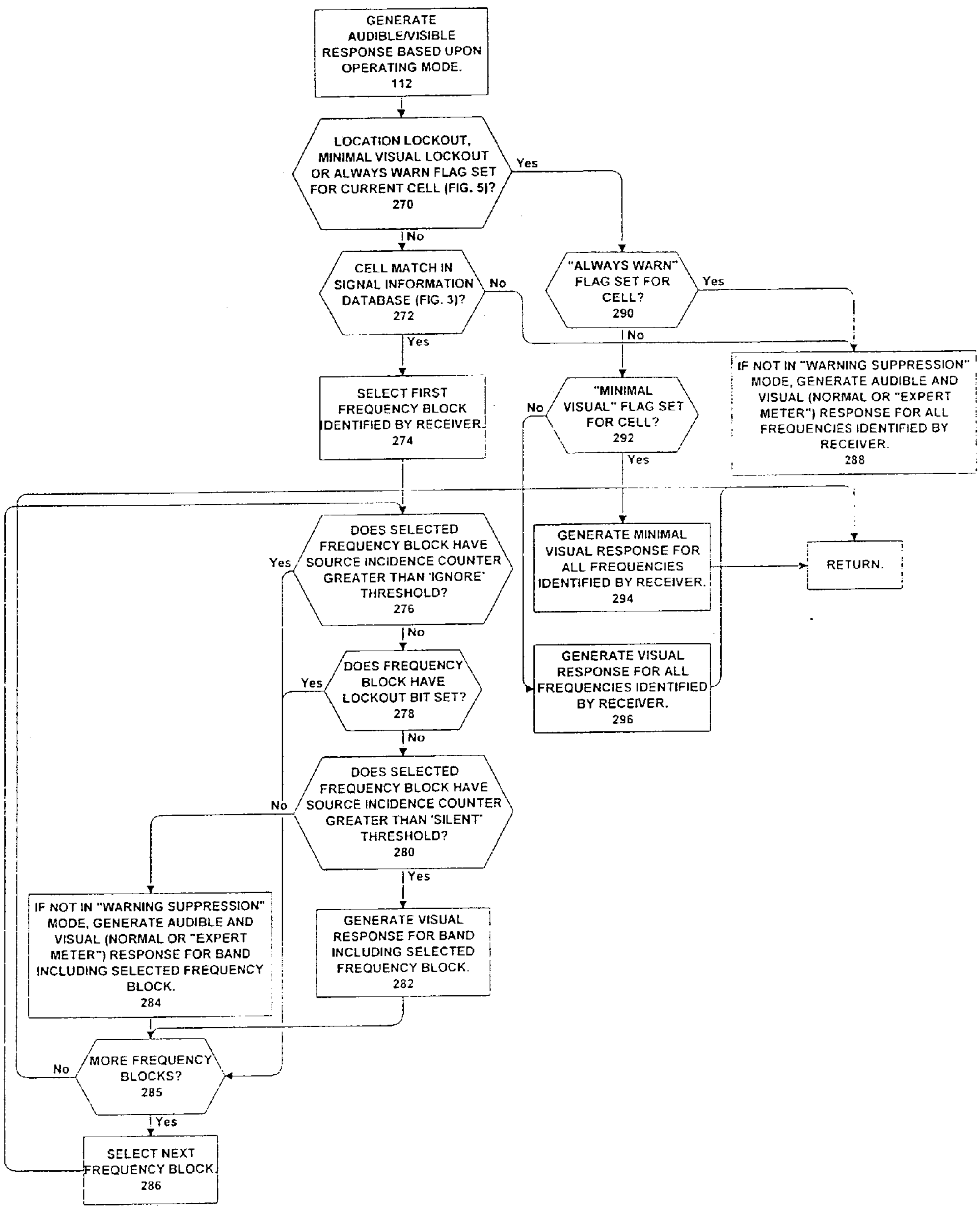

SELECT NON-GPS MODES FROM KEYPAD ACTIVITY. 114
CLEAR ALL GPS RELATED MODES: FREQUENCY, LOCATION AND MINIMAL VISUAL LOCKOUT MODES; ROUTE IDENTIFICATION MODE; POLICE CONFIRMATION MODE; TRAINING MODE; EVERYDAY ROUTE MODE. 262
NO ACTIVITY 224
ENTER/EXIT "DATA OVERWRITE" MODE 222
ENTER/EXIT "EXPERT METER" MODE. 220
ENTER/EXIT "WARNING SUPPRESSION" MODE. 218
RETURN.
ENTER OR EXIT "FREQUENCY LOCKOUT", "LOCATION LOCKOUT" OR "MINIMAL VISUAL LOCKOUT" MODE. 210
ENTER/EXIT "TRAINING" MODE. 212
RETURN.
SELECT MODES FROM KEYPAD ACTIVITY. 110
CLEAR LOCKOUTS 214
COMPARE GRID COORDINATES TO ALL EXISTING DATABASE MEMBERS, SELECT MATCHING AND NEIGHBORING CELLS, AND CLEAR ALL LOCKOUT BITS IN SELECTED CELLS. 216
RETURN.
SET "ALWAYS WARN" BIT FOR CURRENT AND NEIGHBORING CELLS. 232
POLICE CONFIRMATION. 226
IN "SIGNAL TRACKING" MODE? 228
No
Yes
ENTER "POLICE CONFIRMATION" MODE. 230
RETURN.
CLEAR STORED ROUTE START INFORMATION. 254
END/CLEAR EVERYDAY ROUTE 246
IN "ROUTE IDENTIFICATION" MODE? 248
Yes
No
DOES STORED HISTORY ENTRY STILL CONTAIN STORED ROUTE START? 250
Yes
No
COPY ALL CELLS ACCUMULATED IN HISTORY TO EVERYDAY ROUTE STORAGE, OVERWRITING OLDEST ROUTE IF NEEDED. 252
EXIT "ROUTE IDENTIFICATION" MODE. 253
RETURN.
BEGIN EVERYDAY ROUTE. 240
STORE CURRENT CELL AND HISTORY ENTRY LOCATION AS ROUTE START. 242
ENTER "ROUTE IDENTIFICATION" MODE. 244
RETURN
CONFIRM TO CLEAR EVERYDAY ROUTE INFORMATION. 258
Yes
No
ERASE ANY EVERYDAY ROUTE INCLUDING CURRENT CELL. 260
RETURN.

FIG. 6E

FIG. 6F


GENERATE AUDIBLE/VISIBLE RESPONSE BASED UPON OPERATING MODE. 112
LOCATION LOCKOUT, MINIMAL VISUAL LOCKOUT OR ALWAYS WARN FLAG SET FOR CURRENT CELL (FIG. 5)? 270
Yes
No
CELL MATCH IN SIGNAL INFORMATION DATABASE (FIG. 3)? 272
"ALWAYS WARN" FLAG SET FOR CELL? 290
IF NOT IN "WARNING SUPPRESSION" MODE, GENERATE AUDIBLE AND VISUAL (NORMAL OR "EXPERT METER") RESPONSE FOR ALL FREQUENCIES IDENTIFIED BY RECEIVER. 288
SELECT FIRST FREQUENCY BLOCK IDENTIFIED BY RECEIVER. 274
"MINIMAL VISUAL" FLAG SET FOR CELL? 292
DOES SELECTED FREQUENCY BLOCK HAVE SOURCE INCIDENCE COUNTER GREATER THAN 'IGNORE' THRESHOLD? 276
GENERATE MINIMAL VISUAL RESPONSE FOR ALL FREQUENCIES IDENTIFIED BY RECEIVER. 294
RETURN.
DOES FREQUENCY BLOCK HAVE LOCKOUT BIT SET? 278
GENERATE VISUAL RESPONSE FOR ALL FREQUENCIES IDENTIFIED BY RECEIVER. 296
DOES SELECTED FREQUENCY BLOCK HAVE SOURCE INCIDENCE COUNTER GREATER THAN 'SILENT' THRESHOLD? 280
IF NOT IN "WARNING SUPPRESSION" MODE, GENERATE AUDIBLE AND VISUAL (NORMAL OR "EXPERT METER") RESPONSE FOR BAND INCLUDING SELECTED FREQUENCY BLOCK. 284
GENERATE VISUAL RESPONSE FOR BAND INCLUDING SELECTED FREQUENCY BLOCK. 282
MORE FREQUENCY BLOCKS? 285
SELECT NEXT FREQUENCY BLOCK. 286

RADAR WARNING RECEIVER WITH POSITION AND VELOCITY SENSITIVE FUNCTIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a United States continuation-in-part of U.S. Provisional Patent Application serial No. 60/139,097, filed Jun. 14, 1999, and a United States continuation-in-part of U.S. Provisional Patent Application serial No. 60/145,394, filed Jul. 23, 1999, both of which are hereby incorporated herein in their entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to radar warning receivers.

BACKGROUND OF THE INVENTION

[0003] Radar detectors warn drivers of the use of police radar, and the potential for traffic citations if the driver exceeds the speed limit. The FCC has allocated several regions of the electromagnetic spectrum for police radar use. The bands used by police radar are generally as the X, K and Ka bands. Each relates to a different part of the spectrum. The X and K bands are relatively narrow frequency ranges, whereas the Ka band is a relatively wide range of frequencies. By the early 1990's, police radar evolved to the point that it could operate almost anywhere in the 1600-megahertz wide Ka band. During that time radar detectors kept pace with models that included descriptive names like "Ultra Wide" and "Super Wide." More recently, police have begun to use laser (optical) systems for detecting speed. This technology was termed LIDAR for "Light Detection and Ranging."

[0004] Radar detectors typically comprise a microwave receiver and detection circuitry that is typically realized with a microprocessor or digital signal processor (DSP). Microwave receivers are generally capable of detecting microwave components in the X, K, and very broad Ka band. In various solutions, either a microprocessor or DSP is used to make decisions about the signal content from the microwave receiver. Systems including a digital signal processor have been shown to provide superior performance over solutions based on conventional microprocessors due to the DSP's ability to find and distinguish signals that are buried in noise. Various methods of applying DSP's were disclosed in U.S. Pat. Nos. 4,954,828, 5,079,553, 5,049,885, and 5,134,406, each of which is hereby incorporated by reference herein.

[0005] Police use of laser has also been countered with laser detectors, such as described in U.S. Pat. Nos. 5,206,500, 5,347,120 and 5,365,055, each of which is incorporated herein by reference. Products are now available that combined laser detection into a single product with a microwave receiver, to provide comprehensive protection.

[0006] The DSP or microprocessor in a modern radar detector is programmable. Accordingly, they can be instructed to manage all of the user interface features such as input switches, lights, sounds, as well as generate control and timing signals for the microwave receiver and/or laser detector. Early in the evolution of the radar detector, consumers sought products that offered a better way to manage the audible volume and duration of warning signals. Good examples of these solutions are found in U.S. Pat. Nos. 4,631,542, 5,164,729, 5,250,951, and 5,300,932, each of which is hereby incorporated by reference, which provide methods for conditioning the response generated by the radar detector.

[0007] Methods for conditioning detector response are gaining importance, because there is an increasing number of signals present in the X, K, and Ka bands from products that are completely unrelated to police radar. These products share the same regions of the spectrum and are also licensed by the FCC. The growing number of such signals is rapidly undermining the credibility of radar detector performance. Radar detectors cannot tell the difference between emissions from many of these devices and true police radar systems. As a result, radar detectors are increasingly generating false alarms, effectively "crying wolf", reducing the significance of warnings from radar detectors.

[0008] One of the earliest and most prevalent unrelated Microwave sources is the automatic door system used in many commercial buildings such as supermarkets, malls, restaurants and shopping centers. The majority of these operate in the X-Band and produce signals virtually indistinguishable from conventional X-Band Police Radar. Other than the fact that door opening systems are vertically polarized, vs circular polarization for police radar, there is no distinction between the two that could be analyzed and used bv a receiver design.

[0009] Until recently, virtually all of the door opening systems were designed to operate in the X-Band. As a result, radar detectors generally announced X-Band alerts far more often than K-Band. As these X-Band 'polluters' grew in numbers, ultimately 99% of X-Band alerts were from irrelevant sources. X-Band alerts became meaningless. The only benefit that these sources offered the user was some assurance that the detector was actually capable of detecting radar. It also gave the user some intuition into the product's detection range. To minimize the annoyance to users, most radar detector manufacturers added a filter-like behavior that was biased against X-Band sources. Many also added "Band priority" that was biased against X and in favor of bands that were less likely to contain irrelevant sources such as K, Ka, and Laser. If signals in both X and K Bands were detected, band prioritization would announce K, since it was more likely be a threat to the driver. In the last few years, K-Band door opening systems have also grown in number. This has reduced the significance of the K-Band warning and further undercut the overall benefit to the user of a radar detector.

[0010] Another unrelated microwave signal is generated by traffic management systems such as the ARTIMIS manufactured by TRW, used in Cincinnati, Ohio. ARTIMIS Stands for "Advanced Regional Traffic Interactive Management and Information System", and reports traffic flow information back to a central control center. Traffic congestion and other factors are analyzed by the control center. Control center employees use this information to formulate routing suggestions and other emergency information, which they transmit to a large distribution of overhead and roadside signs. In order to collect information on vehicle traffic, a roadside ARTIMIS station transmits an X-Band signal toward cars as they drive by. The ARTIMIS source, unlike the X-Band door opener systems, is distinguishable from police radar as it is not transmitted at a single fixed

frequency. As a result, it is possible to differentiate police radar signals from sources such as ARTIMIS, and ignore ARTIMIS sources in newer detectors. Older detectors, however, do not incorporate this feature and could be obsolete in areas where ARTIMIS is in use.

[0011] Unrelated Microwave signals are also transmitted by a system called the RASHID VRSS. Rashid is an acronym for Radar Safety Brake Collision Warning System. This electronic device warns heavy trucks and ambulances of hazards in their path. A small number of these RASHID VRSS units have been deployed. They are categorized as a member of the 'non-stationary' set of unrelated sources. As in the ARTIMIS example, detection of RASHID can be prevented.

[0012] Perhaps the biggest source of non-stationary unrelated sources is from other radar detectors. These are sometimes referred to as "polluting radar detectors," and present a serious threat to some detector products. An early example of this occurred in the mid 1980's when radar detectors using superhomodyne circuitry became popular. Such detectors leak energy in the X-Band and K-bands and appeared as police radar to other detectors. A solution to this problem is described in U.S. Pat. No. 4,581,769, which is hereby incorporated by reference in its entirety. A similar problem occurred in the early 1990's when the Ka band was widened. An unexpected result was that the wider Ka band then also detected harmonics of.signals generated by local oscillators within many existing radar detectors. U.S. Pat. No. 5,305,007, which is hereby incorporated by reference in its entirety, describes a method for ignoring these polluting detectors.

[0013] At this time, there are very few signal sources that can cause false laser detections in comparison to the substantial list of false microwave signals just described. However there are certain types of equipment that can cause the amplifiers and detection circuitry used in a laser detector to generate a "false" detect. In particular, certain locations near airports have been demonstrated to cause such problems for various laser detector products. As a result, selected airport environments are examples of stationary signals that produce false laser detections.

[0014] As can be appreciated from the foregoing example, as sources of unrelated signals continue to propagate, radar detectors must continually increase in sophistication to filter unrelated sources and accurately identify police radar. Each of these changes and enhancements has the potential effect of obsoleting existing detectors that do not include appropriate countermeasures. Furthermore. some sources. particularly stationary door opener sources, at this time cannot be filtered economically, and thus threaten the usefulness of even the most sophisticated modern radar detector.

[0015] During the 1980's, the functionality of radar detectors expanded into other classes of driver notification. A system was developed that required a special transmitter be placed on emergency vehicles, trains, and other driving hazards. The term 'emergency radar' was coined, and a variety of products were introduced that could detect these transmitters. One such solution was disclosed in U.S. Pat. No. 5,559,508, which is hereby incorporated by reference herein in its entirety. Another system was later introduced offering a larger class of 'hazard categories' called the SWS system. Both emergency radar and SWS involve the transmission of microwave signals in the 'K' band. Such signals are considered to be a part of the group of signal types that are intended to be detected by radar detectors.

[0016] A drawback of these warning systems is that stationary transmitters of these signals send the same message to drivers constantly, and become a nuisance during daily commute. This is beneficial to 'new' drivers receiving the message for the first time. However these messages become an annoyance to drivers who follow the same path to work everyday.

[0017] Thus, radar detector manufacturers are continually confronted with new problems to solve, due to the variety of different types of unrelated sources and their sheer numbers. The rate at which new or upgraded radar detector models are introduced continues to increase as manufacturers try to evolve their products to manage the growing number of unrelated sources. Meanwhile, the market for radar detectors is shrinking because consumers are no longer interested in buying products that so quickly become obsolete.

SUMMARY OF THE INVENTION

[0018] The present invention overcomes these difficulties bv providing a method of operating a radar detector that aids in the management of unrelated sources, and permitting the detector to dynamically improve its handling of unrelated sources. As noted above, many non-stationary sources can be identified and ignored using existing technology. However, many stationary sources cannot, as yet be effectively filtered economically with existing technology. Accordingly, the invention provides a radar detector that includes technology for determining the location of the detector, and comparing this location to the locations of known stationary sources, to improve the handling of such detections.

[0019] In one embodiment, a radar detector may ignore detections received in an area known to contain a stationary source. In the specific embodiment described below, substantially more sophisticated processing is performed to determine whether and what actions to take in response to a detection.

[0020] The Global Positioning Satellite System (GPS) offers an electronic method for establishing current physical coordinates very accurately. In the detailed embodiment described below, a radar detector utilizes a GPS system to determine its current position. The detector also maintain a list of the coordinates of the known stationary source "offenders" in nonvolatile memory. Each time a microwave or laser source is detected, it will compare its current coordinates to this list. Notification of the driver will take on a variety of forms depending on the setup configuration.

[0021] By adding GPS conditioning capabilities to a radar detector, the combination becomes a new product category that is capable of rejecting signals from any given location no matter what the nature of the microwave/laser signals might be from that location. This will have a dramatic effect on the usable life of the product and subsequent value to its owner.

[0022] The above and other objects and advantages of the present invention shall be made apparent from the accompanying drawings and the description thereof.

BRIEF DESCRIPTION OF THE DRAWING

[0023] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate

embodiments of the invention and, together with a general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the invention.

[**0024**] **FIG. 1** is an illustration of a vehicle receiving radar signals from police radar and from a number of unrelated sources, and further receiving global positioning signals from a global positioning satellite;

[**0025**] **FIG. 2** is an electrical block diagram of a radar detection circuit in accordance with principles of the present invention;

[**0026**] **FIG. 3** is a illustration of a database structure used by the radar detection circuit of **FIG. 2**, for storing information radar signals received or receivable from unrelated sources at a number of locations, as identified by cell coordinates;

[**0027**] **FIG. 4** is an illustration of a database structure used for storing historic information on the locations of a vehicle carrying the radar detection circuit of **FIG. 2**, as identified by cell coordinates;

[**0028**] **FIG. 5** is an illustration of a database structure used for storing flags identifying various conditions at a number of locations, as identified by cell coordinates;

[**0029**] **FIG. 6A** is a flow chart of the operations of the CPU of the radar detector of **FIG. 2**, carrying out principles of the present invention;

[**0030**] **FIG. 6B** is a flow chart of operations of the CPU of **FIG. 2** in processing GPS information when GPS signals are being received;

[**0031**] **FIG. 6C** is a flow chart of operations of the CPU of **FIG. 2** in updating stored information when a radar signal is being received; **FIG. 6D** is a flow chart of operations of the CPU of **FIG. 2** in updating stored information when a radar signal is not being received;

[**0032**] **FIG. 6E** is a flow chart of operations of the CPU of Fig.**2** in responding to keypad activity to change operative mode of the GPS enabled radar detector; and

[**0033**] **FIG. 6F** is a flow chart of operations of the CPU of **FIG. 2** in generating audible and visible responses based upon operating modes of the radar detector and the presence or absence of radar signals and stored information.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

[**0034**] To provide background for the present invention, a summary of GPS (Global Positioning System) technology will now be provided. GPS is a mature technology that provides a method for a GPS receiver to determine its relative location and velocity at any time. The (GPS) system is a worldwide constellation of 24 satellites and their ground stations. GPS receivers on earth use 'line of sight' information from these satellites as reference points to calculate positions accurate to a matter of meters. Advanced forms of GPS actually enable measurements to within a centimeter. The Global Positioning System consists of three segments: a space segment of 24 orbiting satellites, a control segment that includes a control center and access to overseas command stations, and a user segment, consisting of GPS receivers and associated equipment. Over time GPS receivers have been miniaturized to just a few integrated circuits and have become very economical.

[**0035**] An unfortunate side effect of the GPS system is that it can be used by enemy forces, as GPS signals can be picked up by any receiver including both domestic and foreign. When the United States Department of Defense devised the GPS system they incorporated a feature that prevents high precision measurements unless the receiver is equipped with special military 'keys.' This is accomplished with the intentional introduction of "noise" into the satellite's clock data which adds noise (or inaccuracy) into position calculations. The DOD sometimes also sends slightly erroneous orbital data to the satellites, which is transmitted back to receivers on the ground. This intentional degradation is referred to as "Selective Availability" or "SA" error. Military receivers use a decryption key to remove the SA errors. As a result of the SA error, there are two classes of GPS service, "Standard Positioning Service (SPS) and "Precise Positioning System" (PPS.). These classes are realized by having GPS satellites transmit two different signals: the Precision or P-code and the Coarse Acquisition or C/A-code. The P-code is designed for authorized military users and provides PPS service. To ensure that unauthorized users do not acquire the P-code, the DOD can engage an encryption segment on the P-code called anti-spoofing (AS). The C/A-code is designed for use by nonmilitary users and provides SPS service. The C/A-code is less accurate and easier to jam than the P-code. It is also easier to acquire, so military receivers first track the C/A-code and then transfer to the P-code. Selective availability is achieved by degrading the accuracy of the C/A-code.

[**0036**] The precision of SPS is stated as providing 100-meter horizontal and 156 meter vertical accuracy "95% of the time." PPS is only available for the U.S. and allied military, certain U.S. Government agencies, and selected civil users specifically approved by the U.S. Government. PPS provides 22 meters horizontal and 22.7 meters vertical accuracy 95% of the time.

[**0037**] Other than intentional errors inserted by the DOD, there are a variety of other error sources that vary with terrain and other factors. GPS satellite signals are blocked by most materials. GPS signals will not pass through buildings, metal, mountains, or trees. Leaves and jungle canopy can attenuate GPS signals so that they become unusable. In locations where at least four satellite signals with good geometry cannot be tracked with sufficient accuracy, GPS is unusable.

[**0038**] The "Differential GPS" system was developed in order to compensate for the inaccuracy of GPS readings. A high-performance GPS receiver (known as a reference station or beacon) is placed at a specific location; the information it receives is then compared to the receiver's location and corrects the SA satellite signal errors. The error data is then formatted into a correction message and transmitted to GPS users on a specific frequency (300 kHz). A true or arbitrary set of coordinates are assigned to the position occupied by a reference GPS receiver. The difference between these and the coordinates received via GPS at the reference is a very close approximation to the SA error at nearby sites. This error is nearly identical to the error calculated by any nearby GPS receiver. The reference site is sometimes referred to as a 'beacon,' as it constantly trans-

mits these difference coordinates. A DPGS receiver is designed to receive both the GPS information and the beacon information. It generates a far more accurate estimate of its coordinates by applying the difference information to the GPS coordinates. The drawback to this is that the remote and reference receivers may not be using the same set of satellites in their computations. If this is the case, and the remote receiver incorporates the corrections, it may be accounting for satellite errors that are not included in its own measurement data. These corrections can make the differential solution worse than the uncorrected GPS position. To prevent this error, an improved form of differential GPS involves the derivation of the corrections to the actual measurements made at the reference receiver to each satellite. By receiving all of the corrections independently, the remote receiver can pick and choose which are appropriate to its own observations. This method of DGPS is most widely used. Typically, the DGPS correction signal loses approximately 1 m of accuracy for ever 150 km of distance from the reference station.

[**0039**] The availability of Beacons for DGPS systems elevate the very threat that the SA error was intended to reduce. In the presence of such networks, potentially hostile weapons systems using DGPS could be developed relatively rapidly. For this reason and others, the SA error has diminished in military significance. The White House has Directed that the S/A error be "Set to Zero" by the year 2006.

[**0040**] In the United States, the US Coast Guard (USCG) and Army Corps of Engineers (ACE) have constructed a network of Beacon stations that service the majority of the eastern United States, the entire length of both coastlines, and the Great Lakes. Further plans exist to increase the density of this network to provide dual redundant coverage throughout the continental US by the end of the year 2000 for a variety of applications including intelligent transportation system, infrastructure management, and public safety.

[**0041**] The Canadian Coast Guard (CCG) provides coverage in Canada for the St. Lawrence River, throughout the Great Lakes, and both coastlines. In total, there are over 160 stations operational worldwide with over 140 sites proposed to come online within the next two years. Coverage currently exists in many other regions of the world including Europe, Asia, Australia, Africa, and South America.

[**0042**] The beacons perform the differential calculation and broadcasts this information by modulating the data onto a 300 kHz signal transmitted by the established network of Radiobeacons. The advantages of using the Beacon DGPS network include: (1) Free access to differential correction information; (2) Long range signal which penetrates into valleys, and travels around obstacles; (3) High quality differential corrections which are continuously monitored for integrity; and (4) Inexpensive user equipment.

[**0043**] The range of the 300 kHz signal is dependent upon a number of factors which include transmission power and conductivity of the surface over which the transmission is propagating. The Beacons within the global network broadcast at varying power. Typical broadcasting ranges for radiobeacons vary from as little as 35 nautical miles to as much as 300 nautical miles. Signals broadcast by DGPS radiobeacons are integrity monitored by remote stations for quality of beacon transmission, differential corrections, and GPS positional information. In addition, government agencies concerned with public safety have made it their mandate to ensure that beacon DGPS services are available 24 hours a day, 365 days a year. Performance requirements for marine applications dictate that an availability of 99% or greater is required if a particular system is to be used as a sole means of navigation. The US Coast Guard and Army Corps of Engineers Beacon Network, for example, offer this high level of availability free of charge to all civilian users.

[**0044**] There are other navigation systems in place, in addition to GPS, that merit review. LORAN-C is a ground-based radio navigation system. It operates on a frequency band of 90 kHz to 110 kHz (LF). It has an approximate range of hundreds to thousands of miles, and an accuracy of 0.25 nautical miles repeatable to 18-90 meters, with 95% confidence. Loran-C is a pulsed hyperbolic system that provides 0.25 nm predictable accuracy, 18-90 m repeatable accuracy, 95% confidence and 99.7% availability. Loran-C provides coverage for the continental U.S. and its coastal waters, the Great Lakes, and most of Alaska. Many other countries are also involved in the providing of Loran-C (or Loran-like) services, or are in negotiations with their neighbors to expand coverage. These countries include India, Norway, France, Ireland, Germany, Spain, Italy, Russia, China, Japan, the Philippines and others.

[**0045**] Omega is a low frequency band system with accuracy of 2 to 4 nautical miles with 95% confidence level. Developed by the United States, it is operated in conjunction with six other nations. OMEGA is a very low frequency, phase comparison, worldwide radionavigation system

[**0046**] Tacan operates in the U.S. in a frequency band of 960 MHz-1215 MHz (UHF). It has a range of approximately 200 miles at high altitudes. TACAN is primarily used by U.S. and other military aircraft. TACAN radio stations are often co-located with civilian VOR systems allowing military aircraft to operate in civil airspace. The system provides the pilot with relative bearing and distance to the radio beacon.

[**0047**] VOR operates in a frequency band of 108.0 MHz-117.95 MHz (VHF). It has an approximate range of 250 miles, but accuracy as poor as 20 miles. VOR is a beacon-based navigation system operated in the U.S. by the Federal Aviation Administration (FAA) for civil aircraft navigation. When used by itself, the system allows users to determine their azimuth from the VOR station without using any directional equipment. VOR stations are radio beacons that transmit two signals. The first, called the reference signal, is transmitted with constant phase all around the transmitter. The second signal is phase shifted from the first depending on the compass direction of the user from the station. A simple, inexpensive receiver in the aircraft is used to determine the received phase difference of the two signals, and from that information the direction of the aircraft from the transmitter. By using two VOR stations, a specific location may be determined.

[**0048**] Of all the navigation systems mentioned, GPS offers better service, more accuracy, and more serviceable regions than any other approach. There are various classes of GPS service that improve accuracy at higher costs. These include the following categories: (1) Low-cost, single receiver SPS projects (100 meter accuracy); (2) Medium-cost. differential SPS code Positioning (1-10 meter accuracy); (3) High-cost, single receiver PPS projects (20 meter

accuracy); (4) High-cost, differential carrier phase surveys (1 mm to 1 cm accuracy); and (5) High-cost, Real-Time-Kinematic (1 cm) with real time accuracy indications.

[0049] Referring now to **FIG. 1, a** vehicle **10** is illustrated in operation on a roadway, under exposure to radio frequency signals from a variety of sources. These include the GPS satellite system, LORAN or OMEGA radio towers, non-police sources of interference such as restaurant **16**, and police radar signals from a radar gun **18**. In accordance with principles of the present invention, vehicle **10** is equipped with a radar detector able to identify the present coordinates and/or velocity of the vehicle, e.g. using an associated GPS receiver or alternatively a receiver of land-based signals such as LORAN. The radar detector is able to use this information to enhance its decision-making abilities.

[0050] Referring now to **FIG. 2**, the radar detector **20** in accordance with principles of the present invention includes a fusion processor **22** for controlling all functions of the unit. Fusion processor receives information on radar signals from a conventional microwave receiver **24**, coupled to processor **22** via a digital signal processor (DSP) **26**. Microwave receiver **24** and DSP **26** may utilize any of the techniques described above and in the above-referenced patents, for rejecting noise and increasing discrimination between actual and spurious police radar signals. Further, receiver **24** and DSP **26** may be controlled by an optional second CPU **25**, which can enable additional signal evaluation beyond that which is possible using a DSP.

[0051] Processor **22** is further connected to a laser detector **28** for detecting police LIDAR signals. Processor **22** is further connected to a GPS receiver **32** and a separate differential GPS (DGPS) receiver **30**, such that differential GPS methodologies may be used where beacon signals are available. Since the radar detector application described in this patent is not a candidate for military class service, it is not able to access the more accurate PPS. However it is considered a "civil user" and can use the SPS without restriction.

[0052] Processor **22** executes a stored program, found in an electrically erasable programmable read only memory (EEPROM) **34**, flash memory, or masked read only memory (ROM). The processor is programmed to manage and report detected signals in various ways depending on its stored program. This programming includes functions for "detector response conditioning," as elaborated below, e.g., with reference to **FIGS. 6A through 6D**.

[0053] The radar detector further incorporates a user input keypad or switches **36**. Operational commands are conveyed by the user to processor **22** via the keypad. Processor **22** is further connected to a display **38**, which may comprise one or more light emitting diodes for indicating various status conditions, or in a more feature-rich device, may include an alphanumeric or graphical display for providing detailed information to a user. A speaker **40** is also provided to enable processor **22** to deliver audible feedback to a user under various alert conditions, as is elaborated below.

[0054] Processor **22** may further include an interface **44**, such as an ODB II compliant interface, for connection to vehicle electronic systems **42** that are built into the vehicle **10**. Modern vehicles are being equipped with standardized information systems using the so-called OBD II standard interface. This standard interface is described in an article entitled ODB II Diagnostics, by Larry Carley, from Import Car, Jan. 1997, which is hereby incorporated herein by reference. Processor **22**, using the OBD II standard interface **44**, can obtain vehicle speed and other vehicle status information directly from the vehicle, and then may use this information appropriately as described in more detail below.

[0055] Processor **22** is further coupled to a Universal Serial Bus (USB) interface **46** that provides a means for uploading and downloading information to and from processor **22**. Specifically, USB interface **46** may be used to automate the assimilation of coordinate information into data structures in EEPROM **34**, as described below with reference to **FIGS. 3 through 5**. USB interface **46** may also be used to interface the detector to a separate host computer or product application containing a larger storage capacity than available from internal memory. Remote storage devices may include any form of dynamically allocatable storage device (DASD) such as a hard disk drive, removable or fixed magnetic, optical or magneto-optical disk drive, or removable or fixed memory card, or any device including a dynamic directory structure or table of contents included in the storage format to permit dynamic storage allocation. The host computer or other connected device need not be visible to the driver and may be in any convenient location, such as under the vehicle dash.

[0056] Coordinate information can be stored, e.g., on a hard drive organized with an indexed database structure to facilitate rapid retrieval, and the hard drive may include a special purpose processor to facilitate rapid retrieval of this information.

[0057] Where a general purpose host computer is connected via the USB interface, it will likely be based on a higher scale CPU chip and thus be able to efficiently carry out complex coordinate comparison tasks such as are described below, and such tasks may be delegated to the host CPU rather than carried out in fusion processor **22**. The host CPU can also anticipate the need for information about particular coordinates based upon vehicle movements, and respond by retrieving records within proximity of the current location for ready deliver, to fusion processor **22**. The host computer can also provide navigational functions to the driver, potentially using stored signal information and flag bits to provide the user with location-specific information about driving hazards and potential police stakeout locations.

[0058] Signal information may also be downloaded from other hosts, for example, a connection may be established directly via the USB interface to an Internet site carrying signal information, as is now done in a text form at the Internet site speedtrap.com. An indirect Internet connection may also be established via a host computer. Furthermore, connections may be established between two receivers, e.g. a trained receiver having extensive signal information, and a receiver having less extensive information, to transfer signal information between the receivers so that either or both has a more complete set of signal information.

[0059] Generally speaking, processor **22** compares the radar detector's immediate coordinates with a stored list of the coordinates of unwanted stationary sources. If the radar detector receives a microwave/laser signal within a certain distance of one of these pre-designated sources, processor **22**

applies additional constraints to the detection criterion before alerting the user. Since stationary radar sources make up the bulk of the unwanted sources, there is a significant benefit resulting from these functions. Further details on these operations are provided below with reference to **FIGS. 6A through 6D**.

[**0060**] **FIG. 3** illustrates data structures **50** stored in EEPROM **34** and used for managing information utilized in accordance with principles of the present invention. As seen in **FIG. 3**, these data structures include a plurality of main entries **52**, each including a field **54** for a coordinate, a field **56** for identifying the date and time data was collected, and three fields **58**, **60** and **62** providing information on the source.

[**0061**] Field **54** provides the coordinate of a "cell" of space. As will be elaborated below, coordinates provided by GPS receiver **32** are reduced in resolution to arrive at a "cell" coordinate, which indicates that the current location of the receiver is within a relatively large (e.g., ⅛ or ¼ mile square) block of space on the Earth's surface. This approach reduces the storage requirements for information stored by the radar detector to a manageable level. The sizes of the cells can be variably adjusted based upon the available memory and the desired precision. In the present example, 128 bits are allocated to storing cell coordinates, so the cell coordinates can only have as much precision as can be provided in 128 bits, a cell, e.g., by discarding the least significant bits of the coordinates. In other applications, different bit sizes and resolutions could be utilized. It will also be noted that the storage requirements can be reduced by designing the receiver for operation only in a specified part of the Earth, eg., only in Europe, Japan or North America. By so doing, part of the coordinates for a cell will not need to be stored because they will be the same for all stored cells. In such an embodiment, whenever the coordinates provided by the GPS receiver fall outside of the pre-established region, the receiver will either disable all storage of information (if approved via operational input from the user), or establish a new region of interest and discard all data from previously identified regions. Alternatively, the operator may set the device in either a "precision" (high coordinate resolution) or "wide area" (low coordinate resolution) mode, based upon the driving habits of the driver. In "wide area" mode, the reduced resolution used for each cell coordinate permits a greater number of coordinates to be stored, albeit with reduced precision as to each coordinate. Rural drivers and others that often follow common paths, would be best suited to "precision" mode, whereas urban drivers would be better suited to "wide area" mode. As a further alternative, the detector may automatically select a mode based upon the memory consumption or the time lapse before the memory of the detector becomes full; if the memory fills rapidly, the unit would automatically switch to a "wide area" mode using low precision coordinates, whereas if the memory never fills or fills only slowly, the unit will remain in its "precision" mode.

[**0062**] The date and time information in field **56** is useful when selecting least recently used (oldest) entries in storage for replacement, as is described further below.

[**0063**] Fields **58**, **60** and **62** store source incidence counters, one for each of a plurality of frequency blocks. Field **58** stores counter(s) for block(s) in the X band. Field **60** stores counter(s) for block(s) in the K band. Field **62** stores counter(s) for block(s) in the Ka band. The number of blocks in each band can vary in different embodiments of the present invention, and is a function of the signal frequency content details provided by the detector **24** and DSP **26**. As one example, the X, K and Ka bands are divided into a total of 32 frequency blocks. Each block is provided a 4-bit counter in fields **58**, **60** and **62**. The counters have a minimum value of 0 and a maximum value of 15, and are a measure of the number of times a signal in the associated frequency block has been detected at that location. As will be described below in greater detail, the "source incidence" counters are used in identifying geographic locations that appear to have spurious sources of police radar signals, due to repeated detection of such signals without confirmation of police activity.

[**0064**] In the data structures shown in **FIG. 3**, to save space, main entries **52** are interleaved with a greater number of differential entries **64**, each of which stores information for a cell. A first field in a differential entry **64** is an index pointer **66** to a main entry **52**, e.g. an index to a storage location at which the main entry is stored. A second field is a differential field **68** that identifies the difference between the coordinate of the differential entry **64** and the coordinate stored in the main entry **52**. The index and differential can be stored in substantially fewer than 128 bits, so that a differential entry **64** is substantially smaller than a main entry, thus saving storage space. Differential entries further include a date and time field **56** and fields **58**, **60** and **62** for storing counters for X, K or Ka frequencies, as described above.

[**0065**] **FIG. 4** illustrates data structures **70** used to store vehicle motion history records or trip records in EEPROM **34**. These data structures include main entries **72** which include field **74** storing a 128 bit cell coordinate, followed by a speed field **76** which can be, for example, 7 bits in length. Differential entries **78** associated with each main entry include a differential coordinate field **80** indicating the difference in the cell coordinate from the associated main entry **72**, and a speed field **76** indicating a speed recorded at the cell. Because motion history records or trip records are stored sequentially during motion of the detector, differential entries **78** are stored after and adjacent to the associated main entry **72**. Accordingly, differential entries **78** do not require an index field to associate the differential entry **78** with a main entry **72**, because the association is implied from the location of the differential entry **78** in memory after its associated main entry **72**.

[**0066**] History entries may be used for a number of purposes. For example, in the following description, history entries are accessed as part of defining an "everyday route" taken by the detector at the operator's identification. History entries may also be used for driver monitoring: they may be downloaded to a host PC via USB interface **46**, and evaluated to determine whether the vehicle has taken abrupt turns, show excessive speed, or entered undesired locations, all of which may be useful in monitoring the activity, e.g., of teenage drivers. History entries may also be uploaded to PC to provide evidence of the driving history of the vehicle before and at the time of a police citation for speeding. If a driver has been unfairly cited for speeding, history records from the detector can provide compelling evidence to court that the citation is in error. For the purpose of enabling these

uses, history entries stored by fusion processor **22** are encrypted when stored and cannot be modified by fusion processor **22** or any PC software supplied for viewing those entries.

[**0067**] **FIG. 5** illustrates data structures **82** that can be used to store hazard information and other flag bits related to cells. These data structures **82** include main entries **84** which include a full 128 bit cell coordinate in field **88**, followed by a date and time field **90** and flag bits **92** indicating the hazard or condition associated with the identified location. The differential entries **86** include an index field **94** pointing to one of the main entries, a differential coordinate field **96** indicating the difference in the cell coordinate from the associated main entry **84**, a date and time field **98**, and a set of flag bits **92** indicating the hazard or condition associated with the identified location. The flag bits may identify various hazard conditions. For example, in the specific embodiment described below, there is an "always warn" flag bit that indicates that police activity has previously been confirmed at the location, and therefore the user should be warned of all apparent police radar signals at the location. Further, there is a "location lockout" flag that indicates that broadband sources of spurious police radar signals have been experienced at the location, and therefore in the future warnings of police radar signals should be suppressed at the location. Similarly, a "minimal visual lockout" flag indicates that, due to the unwanted distraction of spurious police radar warnings at a location, only a minimal visual warning should be made of police radar signals identified at the location. The flag bits further include "frequency lockout" bits, one for each frequency block identified by the radar receiver. These bits identify frequencies at the location in which spurious police radar signals have previously been encountered, so that in the future apparent police radar signals at the same frequencies are ignored. The flag bits may also include additional flags to warn of other conditions, such as that there was construction at the identified location, or that some other cause for traffic slowdowns were seen at the identified location, to aid in vehicle navigation.

[**0068**] The information contained in the databases of **FIGS. 3 and 5** may be assimilated by the detector through operation, as is described below. Alternatively. this information may be pre-installed in the detector, e.g. via an upload from a host PC via the USB port **46**. There would be substantial benefits to pre-training a detector in this way for a particular geographic area. By pre-training the detector, the driver would not have to enure the audible alerts that would naturally occur before it is trained for each source of spurious police radar signals. In a give area, the ideal training profile would not vary much from one detector to the next, since all detectors should reject the same sources in the same areas. As a result, there are few issues that would have to be resolved in order to transfer training information from one radar detector.

[**0069**] The Internet provides a convenient means for storing and accessing repositories of information. Web sites will be established and devoted to this task. They will provide several convenient types of training information. One will be a training file containing the coordinate information from the online "Speed Trap Registry" at the internet site www.speedtrap.com. This information would be usable to set "always warn" bits at the locales of known speed traps. A second type of training information would be training files submitted by individuals for use in particular areas, and the third type of information would be aggregate training files created by integrating individually-submitted information into single files organized by region. Aggregate training files would be managed and updated by the web site administrator.

[**0070**] Training files would have low value if they could not be readily used by other detectors. The transferability of training files from one detector to another will depend on the differences in how real world signals are perceived by their embedded processors. In large part, these differences are a direct result of manufacturing and component variations. During the manufacturing process, a detector goes through a set of calibration steps in order to guarantee that the unit meets specifications for Spectral Band Coverage and Sensitivity. These calibration steps reduce the cost of designing the product since lower cost, poorer tolerance components can be used on the assumption that a final manufacturing calibration procedure will eventually compensate for the lower tolerance. Once calibrated, an acceptable product must also be able to perform over a predefined temperature range.

[**0071**] Component tolerance, manufacturing calibration, and operating temperature are key factors that determine how the spectrum of microwave signals are 'viewed' by the embedded Microprocessor or DSP. Radar products convert the spectral band such as X-Band into an array of values that are proportional to the signal energy in consecutive slots or bins of the spectrum. In order for the product to be 'in tolerance' these slot positions must be adjusted so they precisely cover the full range of X, K, and the Ka bands

[**0072**] The calibration procedure is only concerned with guaranteeing that the slots provide adequate coverage of each band. It is less concerned as to whether any one of these slots falls on a precise physical frequency. Therefore the first frequency block in one detector will not necessary be perceived at the same frequency as the first slot in another detector.

[**0073**] If training data is to be shared between various detectors, it will be necessary for supporting software to compensate for these variations. When new pre-trained data is supplied, the detector will undergo an authentication procedure in order to determine the relationships between the pre-train data and its own receiver configuration. This will be based on comparing the frequencies of newly encountered sources to those of the pre-train data at matching coordinates. By comparing the observed frequencies to those in the training set, a "correction profile" will be constructed, that represents the change between the pre-train data and the output of the local microwave receiver. At the end of the authentication procedure, the entire pre-training file will be incorporated into the active train data. During the authentication procedure, the user will be exposed to unconditioned detector responses. This authentication procedure will be substantially shorter than the training period of a virgin detector. Once authentication is complete, the user will receive a notification indicating that the product is switching from authentication over to normal operation. If the training mode is engaged, the authenticated data will continue to be massaged by new driving encounters, as detailed below.

[0074] Referring now to **FIG. 6**A, operations of the fusion processor **22** to carry out principles of the present invention can be described in greater detail. Fusion processor **22** performs a main loop of steps during regular operation of GPS enabled radar detection. This main loop of steps is illustrated in **FIG. 6**A and is detailed in **FIGS. 6B through 6F**.

[0075] When fusion processor **22** is initialized, i.e., when power to the GPS enabled radar detector is turned on, the device is initialized in step **100**. This initialization step includes performing diagnostic checks on the various circuitry illustrated in **FIG. 2** to insure its proper operation, as well as initialization of the GPS receiver **32** to insure GPS signals can be received accurately by fusion processor **22**. In addition, various internal variables, such as a variable for identifying a current position, are initialized. The initial values are chosen to insure proper operation; for example, the current position variable is initialized to a value that will cause the first pass through the main loop **FIG. 6A** to include processing of a current location in steps **110** and **112** in accordance with FIGS. **6**B-6E, as discussed below.

[0076] The first step in the main loop performed by fusion processor **22**, is step **102**, in which radar detection circuitry **24** and **26** is accessed to obtain information on police radar signals currently being received by the GPS enabled radar detector. In a subsequent step **104**, fusion processor **22** communicates with GPS receiver **32** to request a current location and a current vehicle speed from the GPS receiver **32**. This information can then be utilized in performing GPS related operations described in the following steps. As noted above, vehicle speed may also be obtained from the vehicle itself via an OBDII interface **44** if the vehicle in which the GPS enabled radar detector is installed has a suitable OBD connector for delivering vehicle speed information. It will be appreciated further that vehicle location information might also be obtained via an OBDII connector from a GPS receiver that may be built into the vehicle within which the GPS enabled radar detector is installed. When the vehicle in which the GPS enabled radar detector is installed has both vehicle speed and vehicle position information available via an OBDII connector, the GPS receiver **32** may not be used at all, or may not even be included in the GPS enabled radar detector, to facilitate cost reduction for the GPS enabled radar detector.

[0077] Following steps **102** and **104** in which current police radar and GPS related information is obtained, different actions are taken based upon whether GPS information is available. Specifically, in step **106** it is determined whether a GPS signal has been received. If a GPS signal is available, then all GPS enhanced functions of the radar detector may be performed. If no GPS signal has been received, then the radar detector will revert to processing police radar signals at a manner analogous to conventional non-GPS enabled radar detectors.

[0078] Assuming for the moment that a GPS signal is available in step **106**, and therefore a current position for the vehicle is known, then in step **108** a sequence of steps is preformed to process the GPS signal, as is further detailed below with reference to **FIG. 6B, 6C** and **6D**. This processing can include retrieval and/or updating of stored police radar information and the signal information database illustrated in **FIG. 3**, the vehicle history database illustrated in **FIG. 4**, and/or the flag database illustrated in **FIG. 5**.

[0079] After processing the GPS signal, in step **110** keypad activity on keypad **36** is detected and processed to alter operating modes of the GPS enabled radar detector, as described below in further detail with reference to **FIG. 6E**. The operative modes controllable through the keypad include:

[0080] a "warning suppression" mode in which warnings, particularly audible warnings, produced by the GPS enabled radar detector are suppressed so that they are not disturbing to the operator of the vehicle.

[0081] an "expert meter" mode in which detailed information regarding received warning signals are displayed on display **38** of the GPS enabled radar detector, as described in U.S. Pat. No. 5,668,554, which is hereby incorporated by reference herein in its entirety.

[0082] a "data overwrite" mode in which the GPS enabled radar detector saves, into the signal information database of **FIG. 3**, data regarding any location not previously stored in the database, even when this signal information database is full, by overwriting the oldest data in the signal information database when necessary. When the "data overwrite" mode is disabled, then the signal information database will not be overwritten once it becomes full.

[0083] a "frequency lockout" mode, in which police radar frequencies detected by the receiver are taken to be from non-police sources, and appropriate flags are set in the flag database illustrated in **FIG. 5**. The "frequency lockout" mode is engaged by the vehicle operator when non-police radar signals are being received and the operator wishes to suppress future warning signals caused by the same sources at the same geographic locations. As noted below, "frequency lockout" mode can only be engaged while the GPS enabled radar detector is detecting an apparent police radar signal and will be automatically disengaged when this signal is no longer being received.

[0084] a "location lockout" mode, in which the flag database of **FIG. 5** is updated to suppress all audible warnings of radar signals at the current location of the vehicle. As is the case with the "frequency lockout" mode, the "location lockout" mode will be enabled by a vehicle operator when the vehicle is near to a known source of spurious police radar signals of a broadband character. The "location lockout" mode can only be engaged while the GPS enabled radar detector is detecting an apparent police radar signal, and will be automatically disengaged whenever a police radar signal is no longer being received from the GPS enabled radar detector.

[0085] a "minimal visual lockout" mode, in which the flag database of **FIG. 5** is updated to suppress most or all visual warnings of radar signals at the current location of the vehicle. The "location lockout" mode will be enabled by a vehicle operator when the vehicle is near to a known source of spurious police radar signals of a broadband character, and at that location does not wish to be disturbed by even a visual radar signal warning. The "location

lockout" mode can only be engaged while the GPS enabled radar detector is detecting an apparent police radar signal, and will be automatically disengaged whenever a police radar signal is no longer being received from the GPS enabled radar detector.

[**0086**] a "police confirmation" mode, in which flags in the flag database of **FIG. 5** will be set to insure a warning signal is always delivered for any police radar signal received at the current vehicle location. The "police confirmation" mode will be activated by a vehicle operator upon sighting a police stakeout.

[**0087**] a "training" mode, in which the GPS enabled radar detector will store signal information for all geographic locations that the GPS enabled radar detector reaches or passes during operation. When "training" mode is disabled, the signal incidence counters found in the signal information database of **FIG. 3**, will not be modified by the GPS enabled radar detector during its normal operation.

[**0088**] a "route identification" mode in which the route currently traveled by the vehicle is memorized by the GPS enabled radar detector to be subsequently referenced in performing radar detection. Using "route identification" mode, a user may establish one or more everyday routes traveled by the vehicle, and cause the GPS enabled radar detector to continuously update its signal incidence information in the signal information database of **FIG. 3** whenever one of these routes are traversed. Routes are identified by an operator by entering the "route identification" mode at the beginning a route, and then exiting the "route identification" at the end of the route.

[**0089**] After selecting appropriate modes based upon keypad activity, in step **112**, an appropriate audible or visible response is produced by the GPS enabled radar detector based upon it current operating mode and the presence or absence of radar detector signal received in step **102**. Details of this operation are described below with reference to **FIG. 6F**. After step **112**, processing returns to step **102** to obtain a new radar detector signal output and a new current location and speed and then perform additional analysis of that data as described above.

[**0090**] As noted above, in some circumstances a GPS signal will not be available during operation of the GPS enabled radar detector. In this case, processing continues from step **106** to step **114** in which any non-GPS related operational modes may be activated based upon the activity at keypad **35**. GPS enabled modes are unavailable so long as no GPS signal has been obtained, so the processing in step **114** eliminates those modes which cannot be activated in the absence of a GPS signal. After step **114**, processing continues to step **112** in which an appropriate audible or visible response is generated based upon the current operating mode and the radar detected signal received in step **102**.

[**0091**] Referring now to **FIG. 6**B, the processing performed on a GPS signal in step **108** of **FIG. 6A** can be described in greater detail. As a first step **120**, GPS coordinates received from the GPS receiver **32** are modified by reducing their accuracy. This process is known as "gridding" the coordinates and involves truncating that part of the coordinate of greater accuracy than the defined grid. As a consequence of this modification, the GPS coordinate is mapped into a cell number; every location on the globe falls within a cell of the grid, and has a particular cell number derived from the most significant bits of the GPS coordinates measured within the cell. Cells may be relatively small, i.e., one-eighth of a mile square, or may be relatively large, i.e., one mile square.

[**0092**] After a current cell number is generated from GPS coordinates, then actions are taken based upon whether the vehicle is transitioning from one cell to another, and further based upon current operational modes of the GPS enabled grid are detected. In the first of these steps **122**, it is determined whether the current cell obtained from the GPS receiver is the same a stored prior cell obtained from the GPS receiver during the previous pass through the processing of **FIG. 6B**. If so, the vehicle is in the same cell as has been previously processed, and then no further processing for the current cell is required, and the process of **FIG. 6B** returns.

[**0093**] If, however, the vehicle has moved to a new cell, then in step **124**, the cell number for this new current cell is stored as the prior cell, so that in subsequent passes through the process of **FIG. 6B**. it will be known whether or not the vehicle has moved to another cell.

[**0094**] After step **124**, steps are taken to manage "everyday route" modes of the GPS enabled radar detector. As noted above, the user of the GPS enabled radar detector may establish one or more everyday routes traveled by the vehicle and cause the GPS enabled radar detector to, along those routes continuously update its signal incidence information in the signal information database of **FIG. 3**. Accordingly, when the GPS enabled radar detector detects that it is following one of these everyday routes, then it will automatically enter its everyday route mode, and subsequently perform different processing (as further described below in connection with **FIGS. 6C and 6D**). As seen in **FIG. 6**B, each time the GPS enabled radar detector determines in step **122** that it has passed from one cell to another, then (a.) if the detector has been following an everyday route, an evaluation is made whether the GPS enabled radar detector is continuing to follow the previously defined everyday route, or (b.) if the detector has not been following an everyday route, a determination is made whether the GPS enabled radar detector has started following a previously defined everyday route.

[**0095**] In the first step of this process, in step **126** it is determined whether the GPS enabled radar detector is already in its "everyday route" mode. If the radar detector is not currently not in its "everyday route" mode, then it is determined whether the radar detector is entering an everyday route; specifically, in step **128**, it is determined whether the current cell coordinate is on any of the pre-stored everyday routes. If the current cell is on one of the everyday routes, then the GPS enabled radar detector will determine that the vehicle carrying the detector is beginning or joining one of these pre-stored routes. In such a case, in step **130** the GPS enabled radar detector will enter its "everyday route" mode for the stored route containing the current cell coordinate. If the current coordinate is not on any stored route, step **130** is bypassed.

[**0096**] Returning to step **126**, if the GPS enabled radar detector is already in its "everyday route" mode, then it is

determined whether the detector is continuing to follow this route. In this case, processing proceeds from step **126** to step **132** to determine whether the everyday route is being followed. Specifically, in step **132** it is determined whether the current coordinate is on the current everyday route. If not, then in step **134** the GPS enabled radar detector exits it "everyday route" mode, indicating that the vehicle is no longer on the previously stored everyday route. Otherwise, step **134** is bypassed, and the detector remains in its "everyday route" mode.

[**0097**] Following step **134** or immediately following step **130**, additional steps are performed to determine whether and how to update previously stored signal incidence information in the signal information database of **FIG. 3**. Processing also proceeds to step **140** from steps **132** or directly from step **128** based upon conditions described above.

[**0098**] In step **140** it is determined whether a radar signal is being received by the GPS enabled radar detector. If so, then in step **142** the procedure described below with reference to **FIG. 6C** is performed to update, as needed, the signal information database of **FIG. 3**. If no radar signal is being currently detected, then in step **144** the process described below with reference to **FIG. 6D** is performed to update, as needed, the signal information database of **FIG. 3**. After step **142** or **144**, in step **146** the history database of **FIG. 4** is updated by removing the oldest history entry from that database (if necessary to make room), and creating a new history entry for the current cell. The new history entry will include the cell coordinate or a differential coordinate as discussed above with reference to **FIG. 4**, and would also include a vehicle speed as obtained in step **104** from the GPS receiver or alternatively from an OBD II interface to the vehicle. Following step **146**, the processing of the GPS signal is complete.

[**0099**] Referring to **FIG. 6**C, updating of the signal information database of **FIG. 3** in the presence of a police radar signal can be elaborated. In the first step **150** it is determined whether the GPS enabled radar detector is in its "signal tracking" mode. The "signal tracking" mode is entered whenever the GPS enabled radar detector is receiving an apparent police radar signal as the detector is passing through space. So long as an apparent police radar signal is being continuously detected, the detector will remain in signal tracking mode in order to associate that police radar signal with all of the geographic locations in which it was detected. It will be appreciated that the process of **FIG. 6C** will not commence unless there is a police radar signal being detected; therefore, the first step **150** is to determine whether the detector is in its signal tracking mode, and if not, in step **152** to enter the signal tracking mode to thereby begin tracking the police radar signal that had not previously been detected.

[**0100**] After step **152** or after step **150** if the detector is already in its signal tracking mode, in step **154** the current cell coordinate and the frequency data for the current cell is stored in a special tracking storage area accessible to fusion processor **22** in EEPROM **34**. The frequency data and cell information stored in this tracking storage can be used subsequently to identify the source of the tracked police radar signal more accurately.

[**0101**] After step **154**, different actions are taken based upon whether the signal information database of **FIG. 3** already contains signal information for the detector's current cell coordinate. If there is no matching cells in the signal information database of **FIG. 3**, then processing continues to step **158** in which it is determined whether the signal information database of **FIG. 3** is full, i.e., all the storage space allocated to this database in EEPROM **34** has been consumed. If all the space has been consumed, then in step **160** it is determined whether the GPS enabled radar detector is in its "data overwrite" mode. If so, then the user has identified that current information should be stored for each cell encountered by the vehicle, even when doing so requires the elimination of older stored data. Accordingly, in data overwrite mode, processing proceeds from step **160** to step **162** in which the oldest signal and flag entries in the databases of **FIGS. 3 and 5** are removed, and then to step **164** in which new signal and flag entries are created for the current cell so that signal information and flag information can be stored. If, however, the detector is not in its "data overwrite" mode in step **160**, then a warning is delivered to the user that storage of information is being prevented due to the database being full (step **166**).

[**0102**] After step **166** or **164**, or immediately after step **156** if there is already data stored for the current cell, in step **168** it is determined whether the GPS enabled radar detector is in its "training" or "everyday route" mode. As noted above, in these modes, signal information stored in the database of **FIG. 3** is continuously updated each time a cell is encountered. Accordingly, if the detector is in either its "training" or "everyday route" mode, then in step **170** the unwanted source incidence counter for each frequency block identified by the radar receiver **24** as containing signal, is incremented, preventing an overflow. Subsequently, in step **172** the unwanted source incidence counter for each frequency block identified by the radar receiver **24** as not having signal, is decremented, preventing an underflow. This thus updates the source incidence counters for each frequency block for the current cell. After this processing, or immediately after step **168** if the GPS enabled radar detector is not in the "training" or "everyday route" mode, updating in step **142** is complete.

[**0103**] Referring now to **FIG. 6**D, processing in step **144**, to update various databases when no signal is detected, can be explained. As will be elaborated below, when no police radar signal is being received by the GPS enabled radar detector, this indicates that many of the modes described above for tracking and identifying sources of police radar signal should be terminated.

[**0104**] Specifically, in step **180** it is determined whether the GPS enabled radar detector is in "signal tracking" mode. As discussed above, the "signal tracking" mode signifies that the GPS enabled radar detector is currently tracking the cell locations and frequencies of an apparent police radar signal detected by the GPS enabled radar detector. As discussed above with reference to **FIG. 6**C, step **152**, the GPS enabled radar detector will enter "signal tracking" whenever an apparent police radar signal is received. So long as the signal is continuously received, processing of the GPS signal will pass through step **140** of **FIG. 6B** to **FIG. 6**C, and "signal tracking" mode will remain engaged. If, however, no police radar signal is being received when processing of the GPS signal passes through step **140** of **FIG. 6**B, then processing will pass to **FIG. 6D** and thus to step **180** of **FIG. 6D**. In the first pass through **FIG. 6B** after

a police radar signal has faded, e.g., due to motion of the vehicle past the source of that signal, "signal tracking" mode will still be engaged as a consequence of prior passes through **FIGS. 6B and 6C**. Thus, if in step **180** of **FIG. 6**D, if "signal tracking" mode is engaged, but no police radar signal is currently being received, this indicates that the previously detected signal has just faded. In such a situation, a complete record has been made of the locations in which the source was received by the GPS enabled radar detector. This record can be used to characterize the source as to location and frequency, by analyzing the cells in which the signal was tracked, and the frequencies in which the signal was tracked. Thus, if in step **144**, the GPS enabled radar detector is "signal tracking" mode, in step **182** the detector exits its "signal tracking" mode. Subsequently, steps are taken to store relevant information collected for the tracked signal.

[**0105**] In a first step **184**, it is determined whether the GPS enabled radar detector is in "police confirmation" mode. If so, then the vehicle operator has pressed a key on the keypad of the GPS enabled radar detector indicating that a police stakeout was sighted, during the tracking of apparent police radar signals. In such a case, in step **186** the "always warn" flag bit is set for all or the centralmost cells in the tracked sequence of cells identified while in "signal tracking" mode. Thus, the likely locations of the source of the tracked signal are identified and the flag bits are set so that any apparent police radar signal found in those cells will always cause the user to be warned of police radar.

[**0106**] If the GPS enabled radar detector is not in "police confirmation" mode, in step **188** it is determined whether the GPS enabled radar detector is in "frequency lockout" mode. As described above, the detector will be in "frequency lockout" mode if the vehicle operator has used the keypad to indicate that any apparent police radar signals that were tracked in the preceding and current cell, are from spurious sources, and that the frequencies in which those spurious signals appeared should be ignored in subsequent passes through the same cell location. Accordingly, if the detector is in "frequency lockout" mode in step **188**, processing continues to step **190** in which the lockout bits, in the flag bits **92**, are set for all or central cells of the tracked path taken by the vehicle, for those frequencies that were identified during the "signal tracking" mode.

[**0107**] After step **190**, or immediately after step **188** if the detector is not in "frequency lockout" mode, it is determined whether the receiver is in "location lockout" mode in step **192**. It is noted above, "location lockout" mode is engaged by the vehicle operator when broadband sources of spurious produced radar signals are experienced at a geographic location, and the operator wishes to lockout all frequencies at that location. In such a case, in step **194** all of the frequency lockout bits for all or the centralmost cells in the tracked path of the vehicle are set.

[**0108**] After step **194**, or immediately after step **192** if the detector is not in "location lockout" mode, in step **196** it is determined whether the detector is in "minimal visual" mode. As noted below, the detector will be placed in "minimal visual" mode by the operator when the operator wishes to minimize the indications of police radar signals produced when passing through a geographic region. In such a case, processing continues from step **196** to step **198** in which a minimal visual (MV) flag bit is set in the flag database of **FIG. 5** for all or the centralmost cells in the tracked path of the vehicle.

[**0109**] After step **198**, or immediately after step **196** if the detector is not in "minimal visual" mode, or immediately after step **186** if the GPS enabled radar detector is in "police confirmation" mode, in step **200** it is determined whether the signal information database of **FIG. 3** includes data for matching or neighboring cells to those cells in the tracked path of the vehicle. If such a match is found, then in step **202** it is determined whether the detector is in its "training" or "everyday route" mode. If so, then the detector should update the stored signal information for the current cell. Specifically, to update signal information, in step **204** all of the unwanted source incidence counters for frequency blocks identified by the receiver are decremented, preventing underflow.

[**0110**] Following step **204**, or immediately following step **200** if there is no matching signal information or step **202** if the detector is not in its "training" or "everyday route" mode, in step **206** the "frequency lockout", "location lockout", "minimal visual" and "police confirmation" modes are cleared, because the tracking of a police radar signal has ended, and these modes are therefore no longer relevant to the current location of the vehicle.

[**0111**] Referring now to **FIG. 6**E, the processing of keypad activity to enter and exit the various modes described throughout can be explained. As noted with reference to **FIG. 6**A, various modes are available only if a GPS signal has been obtained from the GPS receiver. If a GPS signal has been obtained then modes are selected from the keypad beginning at step **110**. If a GPS signal has not been obtained then modes are selected from the keypad beginning at step **114**, and a substantial number of modes are disabled and cannot be selected in this circumstance.

[**0112**] The keypad activity to select and deselect a mode may vary based upon the application and style of the GPS enabled radar detector. The display and keypad **38** and **36** may interact to produce a menu system for selecting particular modes and displaying associated information. Alternatively, individual keys of keypad **36** may be utilized to directly activate certain modes. Furthermore, display **38** may include icons or other indicators to identify currently activated modes.

[**0113**] A first collection of modes that may be activated via the keypad **36**, are the "frequency lockout", "location lockout", and "minimal visual lockout" modes. Through interactions with the keypad in step **210**, the user may initiate or terminate these modes. As described above, when initiated, these modes cause lockout information to be stored into flags of the flag database of **FIG. 5** upon termination of tracking an apparent police radar signal. If these modes are not engaged at the time that the police radar signal fades from reception, then no action will be taken to set lockout bits in the flag database of **FIG. 5**. This approach permits a vehicle operator to initiate a lockout mode and then cancel the lockout mode, for example if the operator initially believes a radar signal to be spurious, but then determines that it is in fact being generated by a police source. It will also be noted that, by the operations of **FIG. 6**D, the "police confirmation" mode will override the "lockout" modes, in that if the "police confirmation" mode is engaged when a

police radar signal fades from reception, any "lockout" modes that are engaged will be ignored. The user is not, however, prevented from engaging both modes simultaneously. For example, the user may receive a signal believed to be spurious, and engage a "lockout" mode. The user may then sight a police vehicle and, believing the signal is not spurious, engage "police confirmation" mode. The user may later, however, confirm that the police vehicle is not engaged in a speed trap, and consequently disengage "police confirmation" mode. If the received signal then fades from view, the "lockout" mode will be active and accordingly lockout bits will be set as described above with reference to **FIG. 6D**.

[**0114**] In step **212** the vehicle operator may enter or exit the "training mode", which as described above causes the GPS enabled radar detector to collect signal information for all cells that the vehicle traverses.

[**0115**] A third activity that may be undertaken with the keypad, in step **214**, is to request to clear all lockouts for the current vehicle location. This step may be taken where the GPS enabled radar detector has previously been programmed to lockout a frequency or location and subsequently the vehicle operator sights a police source at that location, and wishes to terminate the lockout at that location. When the vehicle operator requests to clear all existing lockouts, in step **216** the grid coordinates of the vehicle location are compared to all existing members of the flag database of **FIG. 5**, and all matching and/or neighboring cells are selected and all lockout bits in those cells are cleared.

[**0116**] The vehicle operator may also enter or exit a "warning suppression" mode in step **218**, in which a warning for a currently tracked police radar signal is suppressed, i.e., so that the detector does not continue to issue warning signals for the same radar signal received. An operator may also enter or exit an "expert meter" mode in step **220**, requesting that enhanced information on police radar signals received and/or GPS related lockout information or signal incidence information be displayed on display **38** of the detector. An operator may also enter a "data override" mode in step **222**, thus requesting that signal information for new locations visited by the vehicle not found in the database be stored, even at the expense of overriding the oldest previously stored data of this kind. It is also possible, as shown in **FIG. 6**E, that there may be no keypad activity at the time that operation of the detector passes through step **110**. In this circumstance, step **224**, no further processing is performed.

[**0117**] A further action that a vehicle operator may take is to confirm of a police sighting in step **226**. This step causes the detector to enter "police confirmation" mode, so that the detector will ensure that police radar signals at the identified stakeout location is handled with particular urgency. Accordingly, when the user enters a police confirmation in step **226**, then action is taken to set one for more "always warn" flag bits of the flag database of **FIG. 5**.

[**0118**] If at the time that the operator presses the police confirmation, no apparent police radar signal is currently being tracked, then in step **228** the receiver will not be in "signal tracking" mode. In such a circumstance, processing will continue from step **228** to step **232** in which the "always warn" flag bit is set for the current and neighboring cells of the current location of the vehicle. This step ensures that in future times when a police radar signal is detected in these locations, a warning will be delivered to the vehicle operator regardless of other conditions applicable at the time. If a signal is being tracked at the time that the vehicle operator enters a police confirmation, then a slightly different activity is undertaken. Specifically, in this case processing continues from step **228** to step **230** in which the "police confirmation" mode is entered. As noted above with respect to **FIG. 6**D, once the receiver is in police confirmation mode, upon termination of signal tracking, central or all cells along the tracked path of the vehicle when the police radar signal was detected, will be marked as "always warn" in the flag database of **FIG. 5**.

[**0119**] A further activity that may be undertaken by a vehicle operator is to indicate that the vehicle is at the beginning of an everyday route, in step **240**. Doing so causes the GPS enabled radar detector to begin to collect information on the everyday route, for the purpose of ultimately storing a definition of an everyday route to be evaluated in connection with the processing described in connection with **FIG. 6**B, step **128**. When the user indicates that the vehicle is at the beginning of an everyday route, in step **242** the current cell coordinate and the current entry in the vehicle history database of **FIG. 4** are stored for later reference. Then in step **244** the detector enters a "route identification" mode, used later in establishing that a route has been identified and is being tracked. When the user wishes to complete an everyday route or wishes to clear everyday route processing for the current vehicle location, the user engages an end or clear operation in step **246**. When this step is taken by the user, an initial determination is made in step **248** whether the detector is currently in its "route identification" mode. If so, then the user has identified the end of the everyday route that was previously identified in step **240**. Thus, in step **250** it is determined whether the history entry identified and marked in step **242** continues to store the location of the route start that was stored in step **242**. If so, then all of the cells accumulated in the vehicle history following the history entry identified in step **242**, describe the route taken by the vehicle along the path selected by the user. In this case, all cells accumulated in the history database of **FIG. 4** are copied to a special "everyday route" storage area so that all of these cells are available for analysis in connection with the processing of **FIG. 6**B, step **128**. After storing the accumulated history entry cells, in step **252**, processing is completed. After step **252**, in step **253** the "route identification" mode is exited.

[**0120**] If in step **250**, it is determined that the vehicle history database of **FIG. 4** is no longer storing the start of the everyday route defined by the user, then the everyday route defined by the user was too lengthy to be processed by the GPS enabled radar detector. In such a situation, in step **254** the stored route start information is cleared and the "route identification" mode is exited.

[**0121**] If in step **248**, the GPS enabled radar detector is not in "route identification" mode at the time that the vehicle operator requests the end of everyday route in step **246**, then the vehicle operator may wish to delete any everyday route that includes or passes through the current cell. Thus, in step **258**, a display is generated to the operator requesting confirmation that any everyday route including the current cell should be cleared. If a confirmation is received in step **258**, then in step **260** all everyday routes including the current cell

are erased from the everyday route storage of the GPS enabled radar detector. If the vehicle operator does not confirm erasure of everyday route information, then processing completes without erasing any everyday route information.

[0122] In step **114** of **FIG. 6**A, non GPS modes of the GPS enabled radar detector may be activated utilizing keypad activity. This step may be taken if no GPS signal is available at some point during operation of the GPS enabled radar detector. In such a circumstance, in step **262** all GPS related modes of the GPS enabled radar detector are cleared. These include the frequency location and minimal visual lockout modes, the route identification mode, the police confirmation mode, the training mode and the everyday route mode (step **262**). After clearing these modes, non GPS related modes of the GPS enabled radar detector can be initiated. These modes include the "warning suppression" mode (step **218**), the "expert meter" (step **220**), and the "data override" mode (step **222**). Other modes that the operator may attempt to select will be ignored so long as no GPS signal is being received.

[0123] Referring now to **FIG. 6**F, operations performed in connection with generating audible and visible responses to police radar signals can be explained. In a first step **270**, it is determined whether any of a number of lockout or other flags in the flag database of **FIG. 5** are applicable to the current cell. In this step **270**, the flag database is evaluated to see if there is an entry for the current cell, and if so whether the location lockout, minimal visual lockout or always warn flags in that entry are set. If none of these flags are set, then processing of police radar signals at the current location proceeds based upon information in the signal information database of **FIG. 3**, or based upon defaults if there is no previously stored information. Accordingly, if none of the flags identified in step **270** are set, then in step **272** it is determined whether there is a cell match in the signal information database of **FIG. 3**. If there is such a cell match, the frequencies identified by the radar receiver are compared to the signal information in the entry in the database of **FIG. 3**.

[0124] In the first step of this process, the first frequency block identified by the receiver is selected (step **274**). Then, in step **276**, it is determined whether the selected frequency block in the signal information database has a source incidence counter greater than a predetermined "ignore" threshold. If radar signals have been frequently detected in the selected frequency block, but there has never been a police sighting there (and thus the "always warn" flag has never been set), this is strongly indicative of a false source at that location. Accordingly, if the source incidence counter for a frequency block exceeds the "ignore" threshold, then any police radar signals identified in that frequency block are ignored. If, however, the selected frequency block does not have a source incidence counter greater than this threshold, then in step **278** it is determined whether the frequency block has a lockout flag bit set in the flag database of **FIG. 5**. Only if the frequency lockout bit for the selected frequency is not set, will processing continue to step **280**. In step **280** it is determined whether the selected frequency block has a source incidence counter greater than a "silent" threshold. If the source incidence counter exceeds this threshold, then it is likely that there is a false source radar signals at the location, and as a result in step **282** a visual-only response is generated for the frequency band including the selected frequency block. If, however, the selected frequency block does not have a source incidence counter greater than the silent threshold, then an audible and visual response can be generated. In step **284** it is determined whether the receiver is in "warning suppression" mode. If not in this mode, then an audible and visual response is generated for the band of signals including the selected frequency block. Visual response may be a normal response or may be an "expert meter" response depending upon the status of the "expert meter" mode of the receiver.

[0125] After steps **282** or **284**, or immediately after steps **276** or **278** if a frequency block is to be ignored or has been locked out, in step **285** it is determined whether there are additional frequency blocks to be evaluated. If so, then in step **286** the next frequency block is selected and processing returns to step **276**. After all frequency blocks have been evaluated, processing ends at step **285**, and the generation of audible and visual responses is completed.

[0126] Returning to step **270**, if one of the location lockout, minimal visual lockout or always warn flags are set for the current cell, then in step **290** and in step **292** it is determined which of these flags is set. If the "always warn" flag is set for the current cell, then in step **288** an audible and visual response is generated for all frequencies identified by the received, unless suppressed by "warning suppression mode". Step **288** is also performed following step **272** if there is no match for the current cell in the signal information database.

[0127] If the "minimal visual" flag is set for a current cell, but the "always warn" flag is not, processing proceeds from step **290** to step **292** and then to step **294** in which a minimal visual response is generated for all frequencies identified by the receiver, such as a small blinking flag on the display of the detector.

[0128] If the "always warn" and "minimal visual" flags are not set, but the "location lockout" flag is set for the current cell, then processing continues from step **270** through steps **290** and **292** to step **296**, in which a visual-only response is generated for all frequencies identified by the receiver, which may include expert meter information or other details available from the detector.

[0129] After step **288**, **294** or **296** processing to generate an audible and/or visual response is completed.

[0130] While the present invention has been illustrated by a description of various embodiments and while these embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art.

[0131] For example, it will be appreciated that principles of the present invention may also be applied to systems that do not include a GPS receiver. For example, in a simplified embodiment of the present invention, the radar warning receiver may automatically enter its "warning suppression" mode based upon the speed of the vehicle. The speed of the vehicle may, of course, be obtained from a GPS receiver, but if a GPS receiver is not available and/or unnecessarily expensive to include in the receiver, the receiver could obtain vehicle speed information directly from the vehicle's

on-board information processing system via the ODB II interface discussed above. A threshold speed of 15 MPH could be used as a default, with "warning suppression" mode automatically engaged at speeds below this threshold. This threshold may be user-adjustable, e.g., within a range such as 5 to 50 MPH.

[0132] The interface connector used by the receiver may take other forms than the known USB standard. It may use any computer interface standard (e.g., IEEE 488), or an automotive wiring standard, the J1854, CAN, BH12 and LIN standards, or others.

[0133] In a more refined embodiment, a "everyday route" mode could be included, in which the operator can perform "everyday route velocity" training. In this "everyday route velocity" training mode, the vehicle speed at each point along the "everyday route" would be stored along with the cell locations along the route. Subsequently, when the detector determines that it is on a previously defined everyday route, it will enter "warning suppression" mode whenever the vehicle speed is within a tolerance of, or below, the velocity recorded when in "everyday route velocity" training mode. Thus, no warning signals will be generated so long as the vehicle is not traveling faster than the threshold speed identified by the operator during "everyday route velocity" training of the detector.

[0134] It will be further appreciated that the "signal tracking" mode described herein may operate upon each frequency band independently, so that the "signal tracking" mode may be engaged for one band while disengaged for others, and so that the fade-out of a tracked signal at one frequency will cause flag bits to be set for that frequency while other frequencies continue to be tracked.

[0135] It will be further appreciated that the determination of whether to generate an audible or visual response, or both, may be based on information in addition to the flags applicable to the current cell of the vehicle. For example, the flags in cells recently traversed by the vehicle may also be consulted to determine whether audible or visual signals should be suppressed at a current cell. Thus, for example, if the detector passes through a cell that has been marked for "minimal visual" lockout, warnings will be suppressed for subsequent cells entered by the vehicle while the same signal is being tracked, regardless of whether flag bits in those cells call for a lockout.

[0136] The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and method, and illustrative example shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of applicant's general inventive concept.

What is claimed is:

1. A police warning receiver comprising:

a receiver section adapted to receive electromagnetic signals indicative of police activity;

an alert section responsive to the receiver section and adapted to provide an alert if a received electromagnetic signal correlates to a police signal; and

a position determining circuit generating a location signal;

wherein the alert section is further responsive to the location signal and adapted to alter or not provide the alert if the location signal correlates to a location of a rejectable signal.

2. The police warning receiver of claim 1, wherein said electromagnetic signals include radar signals in a radar band.

3. The police warning receiver of claim 1, wherein said electromagnetic signals are carried in the visible or infrared spectrum.

4. The police warning receiver of claim 1, wherein the alert section further correlates said rejectable signal to said received electromagnetic signal, and alters the alert based upon the result of the correlation.

5. The police warning receiver of claim 1 wherein said rejectable signal is correlated to said received electromagnetic signal by comparing frequencies of said rejectable signal to frequencies of said received signal.

6. The police warning receiver of claim 5 further comprising storage for signal information associated with geographic locations, said signal information identifying rejectable signals at each geographic location.

7. The police warning receiver of claim 6 wherein said storage for signal information includes a signal incidence counter identifying a number of times a signal has been received by said receiver.

8. The police warning receiver of claim 7 wherein said storage for signal information includes a plurality of signal incidence counters, each associated with a frequency block and identifying a number of times a signal within the associated frequency block has been received by said receiver.

9. The police warning receiver of claim 8 wherein frequencies of said received signal are compared to frequencies in said signal information database to identify frequencies of said received signal having low valued signal incidence counters.

10. The police warning receiver of claim 9 wherein, upon identification of a frequency of said received signal having a low valued signal incidence counter in said signal information database, an alert signal is provided.

11. The police warning receiver of claim 1 further comprising storage for flags associated with geographic locations, said flags identifying rejectable signals at each geographic location.

12. The police warning receiver of claim 11 wherein

said flags include a flag associated with each of a plurality of frequencies identified by said receiver, and indicating whether received signals of the associated frequency are rejectable; and

said received electromagnetic signal is correlated to rejectable signals by comparing frequencies of said received signal to rejectable signal frequencies identified by said flags.

13. The police warning receiver of claim 11 wherein

said flags include a flag associated with a geographic location indicating that all signals received at said geographic location are rejectable; and

said alert section is adapted to alter or not provide the alert if a flag associated with the location signal indicates that all signals received at said geographic location are rejectable.

14. The police warning receiver of claim 11 wherein

said flags include a flag associated with a geographic location indicating that all signals received at said geographic location are rejectable and should be minimally visually identified; and

said alert section is adapted to provide a minimal visual alert if a flag associated with the location signal indicates that all signals received at said geographic location are rejectable and should be minimally identified.

15. The police warning receiver of claim 1 further comprising storage for signal information associated with geographic locations, said signal information identifying rejectable signals at each geographic location.

16. The police warning receiver of claim 15 further comprising an interface connector,

wherein signal information is stored in said storage via said interface connector.

17. The police warning receiver of claim 1 adapted to access signal information associated with geographic locations, said signal information identifying rejectable signals at each geographic location.

18. The police warning receiver of claim 17 further comprising communication circuitry for obtaining said signal information from an Internet resource.

19. The police warning receiver of claim 17 further comprising communication circuitry for obtaining said signal information from a general purpose computer.

20. The police warning receiver of claim 17 further comprising communication circuitry for obtaining said signal information from another police warning receiver.

21. The police warning receiver of claim 16 wherein said interface connector complies with one of a universal serial bus standard, an automotive wiring standard, the J1854, CAN, BH12 and LIN standards.

22. The police warning receiver of claim 15 wherein said receiver has a training mode in which said signal information is modified based upon electromagnetic signals received by the police warning receiver.

23. The police warning receiver of claim 22 wherein

said signal information comprises a signal incidence counter associated with a geographic location,

said signal incidence counter is incremented upon reception of an electromagnetic signal at said geographic location, and

said signal incidence counter is decremented upon failure to receive an electromagnetic signal at said geographic location.

24. The police warning receiver of claim 23 wherein

said signal information comprises a plurality of signal incidence counters each associated with a geographic location and a frequency block,

a signal incidence counter is incremented upon reception of an electromagnetic signal in an associated frequency block at an associated geographic location, and

a signal incidence counter is decremented upon failure to receive an electromagnetic signal in an associated frequency block at an associated geographic location.

25. The police warning receiver of claim 24 wherein

said frequency blocks are associated with frequencies of radar-band electromagnetic signals, and

said signal incidence counters are incremented and decremented upon reception or failure to receive a radar-band electromagnetic signal.

26. The police warning receiver of claim 1 further comprising storage for vehicle history information identifying vehicle activities including geographic locations entered by a vehicle carrying said receiver.

27. The police warning receiver of claim 26 wherein said vehicle history information comprises geographic locations entered by a vehicle carrying said receiver and velocities of said vehicle at said locations.

28. The police warning receiver of claim 1 wherein said receiver is responsive to a user input confirming police activity, to identify one or more geographic locations in which electromagnetic signals are not rejectable.

29. The police warning receiver of claim 1 further comprising storage for route information identifying geographic locations relevant to a route traveled by a vehicle carrying said receiver.

30. The police warning receiver of claim 29 further comprising storage for signal information associated with geographic locations of said route, said signal information identifying rejectable signals at each geographic location of said route, wherein said receiver detects transit of said vehicle along said route and in response accesses said signal information to identify rejectable signals.

31. The police warning receiver of claim 30 wherein said receiver modifies said signal information based upon electromagnetic signals received by the police warning receiver while traveling said route.

32. The police warning receiver of claim 31 wherein

said signal information comprises a signal incidence counter associated with a geographic location,

said signal incidence counter is incremented upon reception of an electromagnetic signal at said geographic location, and

said signal incidence counter is decremented upon failure to receive an electromagnetic signal at said geographic location.

33. The police warning receiver of claim 32 wherein

said signal information comprises a plurality of signal incidence counters each associated with a geographic location and a frequency block,

a signal incidence counter is incremented upon reception of an electromagnetic signal in an associated frequency block at an associated geographic location, and

a signal incidence counter is decremented upon failure to receive an electromagnetic signal in an associated frequency block at an associated geographic location.

34. The police warning receiver of claim 1 wherein said receiver tracks geographic locations in which electromagnetic signals are continuously received.

35. The police warning receiver of claim 34 wherein said receiver is responsive to a police confirmation by a user thereof to identify tracked geographic locations in which electromagnetic signals have been continuously received, as not rejectable.

36. The police warning receiver of claim 34 wherein said receiver is responsive to a location lockout by a user thereof

to identify tracked geographic locations in which electromagnetic signals have been continuously received, as not rejectable.

37. The police warning receiver of claim 34 wherein said receiver tracks geographic locations in which electromagnetic signals of each of a plurality of frequencies are continuously received.

38. The police warning receiver of claim 37 wherein said receiver is responsive to a frequency lockout by a user thereof to identify tracked geographic locations and frequencies in which electromagnetic signals have been continuously received, as not rejectable.

39. The police warning receiver of claim 15 wherein said receiver stores signal information for geographic locations for which no signal information has previously been stored.

40. The police warning receiver of claim 39 wherein said receiver has a data overwrite mode in which signal information is erased to provide room to store signal information for geographic locations for which no signal information has previously been stored, and a mode in which erasure of signal information is prevented.

41. The police warning receiver of claim 1 wherein said receiver has a warning suppression mode in which the alert section is adapted to alter or not provide an alert.

42. The police warning receiver of claim 1 wherein said receiver has an expert meter mode in which the alert section is adapted to display detailed information on said received signal.

43. A police warning receiver comprising:

a receiver section adapted to receive electromagnetic signals indicative of police activity;

an alert section responsive to the receiver section and adapted to provide an alert if a received electromagnetic signal correlates to a police signal; and

a position determining circuit generating a location signal;

storage for vehicle history information identifying vehicle activities including geographic locations entered by a vehicle carrying said receiver.

44. The police warning receiver of claim 43 wherein said vehicle history information comprises geographic locations entered by a vehicle carrying said receiver and velocities of said vehicle at said locations.

45. The police warning receiver of claim 43, wherein said electromagnetic signals include radar signals in a radar band.

46. The police warning receiver of claim 43, wherein said electromagnetic signals are carried in the visible or infrared spectrum.

47. The police warning receiver of claim 43 wherein said storage further stores signal information associated with geographic locations, said signal information identifying rejectable signals at geographic locations, said receiver correlating a received electromagnetic signal to rejectable signals at a geographic location corresponding to said location signal, and altering or not providing an alert if the rejectable signals correlate to the received electromagnetic signal.

48. The police warning receiver of claim 43 adapted to access signal information associated with geographic locations, said signal information identifying rejectable signals at each geographic location.

49. The police warning receiver of claim 48 further comprising communication circuitry for obtaining said signal information from an Internet resource.

50. The police warning receiver of claim 48 further comprising communication circuitry for obtaining said signal information from a general purpose computer.

51. The police warning receiver of claim 48 further comprising communication circuitry for obtaining said signal information from another police warning receiver.

52. The police warning receiver of claim 43 further comprising an interface connector,

wherein vehicle history information may be retrieved from said storage via said interface connector.

53. The police warning receiver of claim 52 wherein said interface connector complies with one of a universal serial bus standard, an automotive wiring standard, the J1858, CAN, BH12 and LIN standards.

54. A police warning receiver comprising:

a receiver section adapted to receive electromagnetic signals indicative of police activity;

an alert section responsive to the receiver section and adapted to provide an alert if a received electromagnetic signal correlates to a police signal; and

a dynamically allocatable storage device storing information accessible to said receiver or alert sections, and storing information usable by said receiver or alert sections in receiving or correlating electromagnetic signals.

55. The police warning receiver of claim 54, wherein said electromagnetic signals include radar signals in a radar band.

56. The police warning receiver of claim 54, wherein said electromagnetic signals are carried in the visible or infrared spectrum.

57. The police warning receiver of claim 54, wherein said storage device stores information on rejectable signals, and the alert section further correlates a rejectable signal to said received electromagnetic signal, and alters the alert based upon the result of the correlation.

58. The police warning receiver of claim 54 wherein said rejectable signal is correlated to said received electromagnetic signal by comparing frequencies of said rejectable signal to frequencies of said received signal.

59. The police warning receiver of claim 58

further comprising a position determining circuit generating a location signal,

wherein said storage device stores signal information associated with geographic locations, said signal information identifying rejectable signals at each geographic location, and

wherein said alert section correlates a rejectable signal for a location corresponding to said location signal, to said received electromagnetic signal, and alters the alert based upon the result of the correlation.

60. The police warning receiver of claim 59 adapted to access and store said signal information associated with geographic locations from external sources.

61. The police warning receiver of claim 60 further comprising communication circuitry for obtaining said signal information from an Internet resource.

62. The police warning receiver of claim 60 further comprising communication circuitry for obtaining said signal information from a general purpose computer.

63. The police warning receiver of claim 60 further comprising communication circuitry for obtaining said signal information from another police warning receiver.

64. The police warning receiver of claim 54 wherein said mass storage device stores vehicle history information identifying vehicle activities including velocities of a vehicle carrying said receiver.

65. The police warning receiver of claim 64

further comprising a position determining circuit generating a location signal,

wherein said vehicle history information comprises geographic locations entered by a vehicle carrying said receiver and velocities of said vehicle at said locations.

66. The police warning receiver of claim 54 further comprising an interface connector,

wherein information is stored in said storage device via said interface connector.

67. The police warning receiver of claim 66 wherein said interface connector complies with one of a universal serial bus standard, an automotive wiring standard, the J1862, CAN, BH12 and LIN standards.

68. A police warning receiver comprising:

a receiver section adapted to receive electromagnetic signals indicative of police activity;

an alert section responsive to the receiver section and adapted to provide an alert if a received electromagnetic signal correlates to a police signal;

a display for displaying information to a user;

a position determining circuit generating a location signal; and

storage for information relating to prior encounters of electromagnetic signals by the police warning receiver at geographic locations;

wherein information presented on said display is derived from information relating to a prior encounter of an electromagnetic signal at a geographic location corresponding to the location signal.

69. The police warning receiver of claim 68, wherein said electromagnetic signals include radar signals in a radar band.

70. The police warning receiver of claim 68, wherein said electromagnetic signals are carried in the visible or infrared spectrum.

71. The police warning receiver of claim 68, wherein the alert section correlates information relating to a prior encounter of an electromagnetic signal to said received electromagnetic signal, and alters the alert based upon the result of the correlation.

72. The police warning receiver of claim 68 wherein said information relating to prior encounters of electromagnetic signals comprises signal information identifying signals received at each geographic location.

73. The police warning receiver of claim 72 wherein said signal information includes a signal incidence counter identifying a number of times a signal has been received by said receiver at each geographic location.

74. The police warning receiver of claim 68 wherein said information relating to prior encounters of electromagnetic signals comprises flags associated with geographic locations, said flags identifying rejectable signals at each geographic location.

75. The police warning receiver of claim 68 further comprising an interface connector,

wherein information relating to prior encounters of electromagnetic signals is stored in said storage via said interface connector.

76. The police warning receiver of claim 75 wherein said interface connector complies with one of a universal serial bus standard, an automotive wiring standard, the J1862, CAN, BH12 and LIN standards.

77. The police warning receiver of claim 68 adapted to access and store said information relating to prior encounters from external sources.

78. The police warning receiver of claim 77 further comprising communication circuitry for obtaining said signal information from an Internet resource.

79. The police warning receiver of claim 77 further comprising communication circuitry for obtaining said signal information from a general purpose computer.

80. The police warning receiver of claim 77 further comprising communication circuitry for obtaining said signal information from another police warning receiver.

81. A police warning receiver comprising:

a receiver section adapted to receive electromagnetic signals indicative of police activity;

an alert section responsive to the receiver section and adapted to provide an alert if a received electromagnetic signal correlates to a police signal; and

a digital interface connector,

wherein said police warning receiver is configurable in response to digital signals received via said digital interface connector.

82. The police warning receiver of claim 81, wherein said electromagnetic signals include radar signals in a radar band.

83. The police warning receiver of claim 81, wherein said electromagnetic signals are carried in the visible or infrared spectrum.

84. The police warning receiver of claim 81 wherein said interface connector complies with one of a universal serial bus standard, an automotive wiring standard, the J1866, CAN, BH12 and LIN standards.

85. The police warning receiver of claim 81 wherein said interface connector is connectable to a digital computer for configuration of said receiver.

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